Dec. 30, 1924. 1,521,069

E. BERN

BAFFLE WALL FOR DRAINAGE DITCHES

Filed Nov. 2, 1923 2 Sheets-Sheet 1

Fig. 3

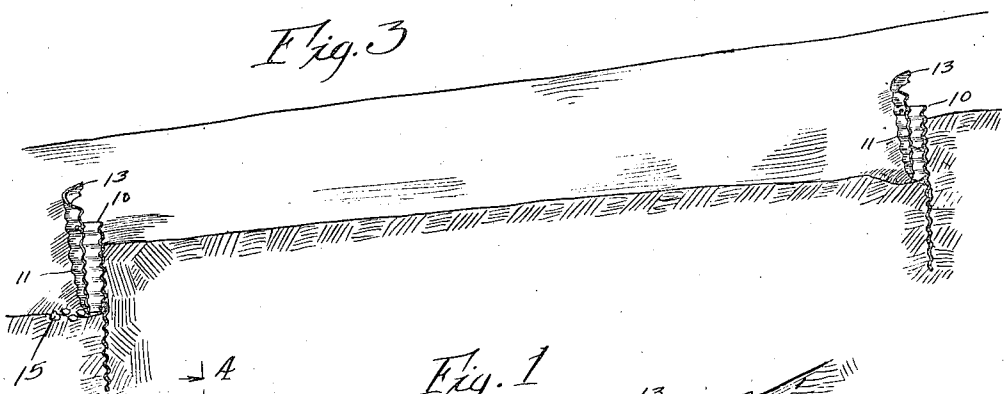


Fig. 1

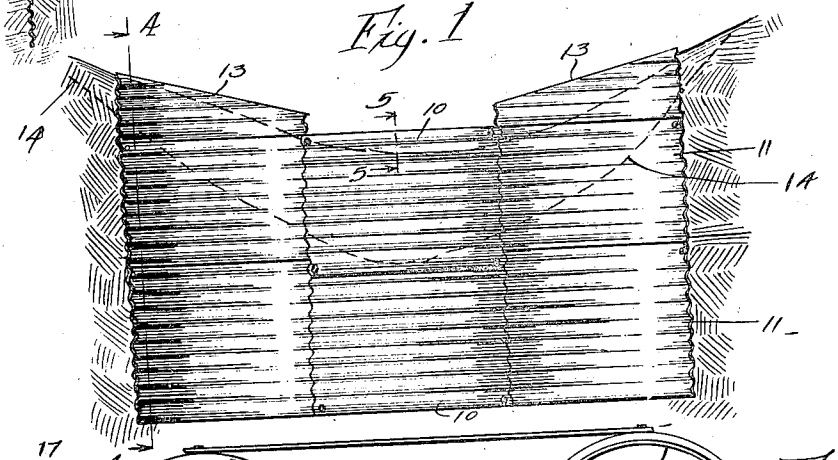


Fig. 2

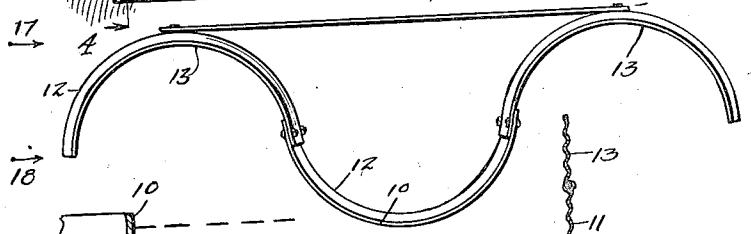


Fig. 4

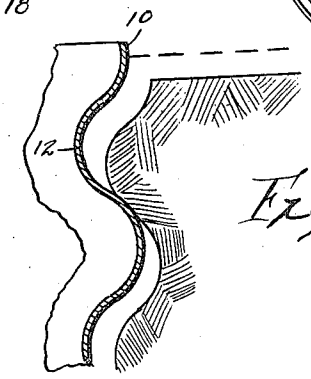


Fig. 5

Witness
Lynn Latta

Inventor
Emil Bern
By
Baird & Freeman
Atty's

Dec. 30, 1924. 1,521,069

E. BERN

BAFFLE WALL FOR DRAINAGE DITCHES

Filed Nov. 2, 1923 2 Sheets-Sheet 2

Fig. 9

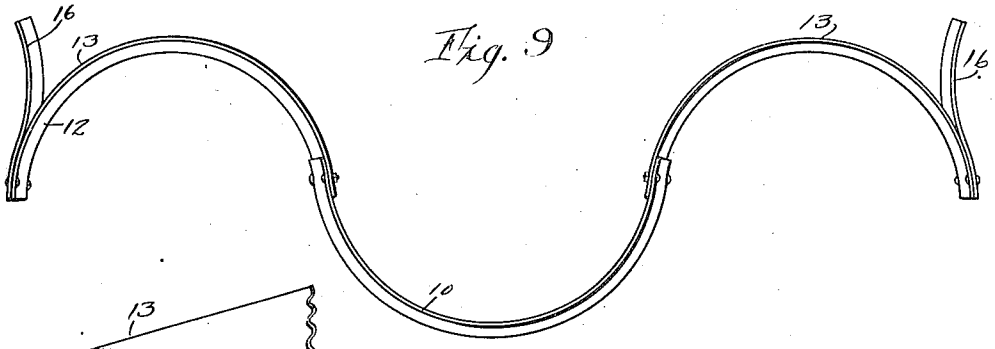


Fig. 8

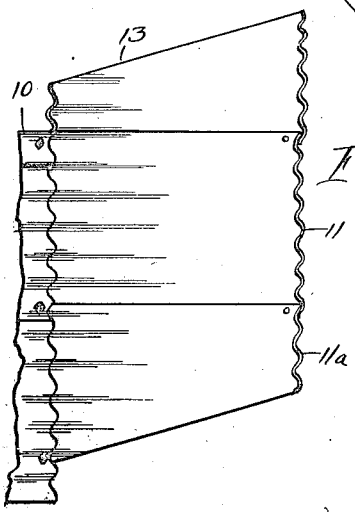


Fig. 6

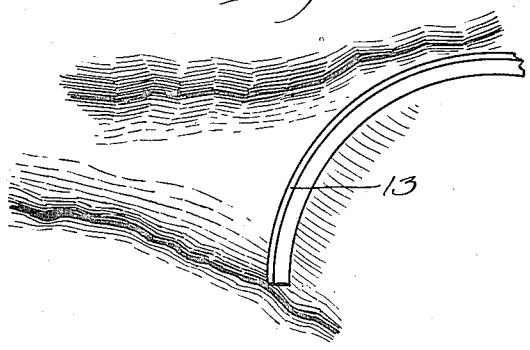
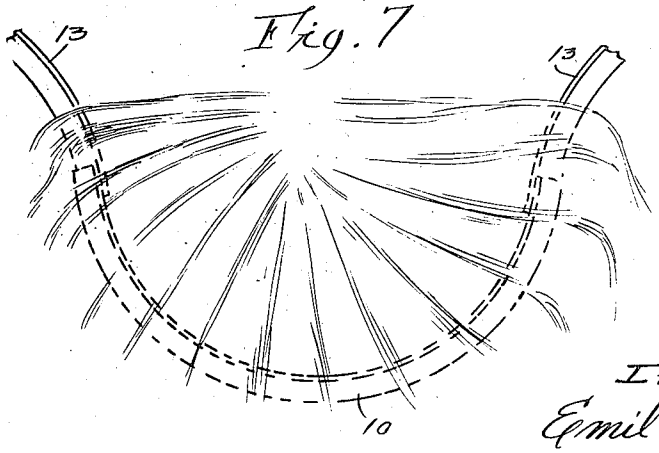


Fig. 7



Witness
Lynn Latta

Inventor
Emil Bern

By Bair & Freeman
Attys

Patented Dec. 30, 1924. 1,521,069

UNITED STATES PATENT OFFICE.

EMIL BERN, OF DES MOINES, IOWA.

BAFFLE WALL FOR DRAINAGE DITCHES.

Application filed November 2, 1923. Serial No. 672,317.

To all whom it may concern:

Be it known that I, EMIL BERN, a citizen of the United States, and a resident of Des Moines, in the county of Polk and State of Iowa, have invented a certain new and useful Baffle Wall for Drainage Ditches, of which the following is a specification.

The purpose of my invention is to provide a baffle wall of simple, durable and inexpensive construction for drainage ditches and the like.

Generally speaking, it is my object to provide a baffle wall of novel construction having a number of advantages hereinafter more fully referred to.

More particularly, it is my object to provide a baffle wall adapted to be placed in a drainage ditch or the like, comprising a central portion, which in the preferred form of my invention, has substantially the form of a half circle opening downwardly with relation to the flow of water in the ditch and having end portions which in the preferred form are connected with the central portion and open upwardly with relation to the flow of water in the ditch.

A further purpose is to provide in such a baffle wall horizontal corrugations or their equivalents for accomplishing a variety of purposes hereafter explained.

Another object is to provide in such a baffle wall a transverse brace for the upper ends of the end portions.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 shows an elevation of my baffle wall viewed from the upper part of the ditch.

Figure 2 shows a top or plan view of the same.

Figure 3 shows a longitudinal, vertical, sectional view of the ditch, showing two of the spaced walls in section.

Figure 4 shows a vertical, sectional view taken on the line 4—4 of Figure 1.

Figure 5 shows an enlarged, vertical, sectional view taken on the line 5—5 of Figure 1, looking in the direction indicated by the arrows.

Figure 6 shows a plan view of a portion of one end of the baffle wall and the ditch illustrating somewhat in diagram one of the functions of the end member.

Figure 7 is a diagrammatic view illustrating the flow of water over the central portion of the baffle wall, as viewed from above.

Figure 8 shows an elevation similar to the view shown in Figure 1 of an end of the baffle wall of a slightly modified form; and

Figure 9 shows a top view of another modification of my invention.

I will first describe the structure of my baffle wall in a preferred form in which it may be embodied and will then explain the purposes and functions of the wall and some of the advantages resulting from its structure for accomplishing these purposes and functions.

In modern road building, it is the custom to provide drainage ditches at the sides of the highway. Where the road is not level, but is located on a hillside of greater or less inclination, the building of these ditches becomes a matter of great importance for the reason that in times of heavy rains and when the flow of water is considerable, the ditches wash out and sometimes destroy the road.

It is a matter of prime necessity that the ditches be so constructed and that such means be provided as to provide for the carrying off of water by the ditches with a minimum washing of the ditches and minimum injury to the highway.

In general practice, where the road is inclined from the level, it is the custom to provide at the side of the road, ditches which usually are about eighteen inches wide at the bottom.

Heretofore, it has been found that in order to reduce the washing to a minimum, it is desirable at certain intervals depending upon the fall of the ditch and upon the condition of the soil, the size of the ditch and so forth to provide in the ditch baffle walls.

The common practice has been to place a straight, transverse wooden wall in the ditch. These wooden walls have been sub-

ject to many disadvantages which will be again referred to in connection with the explanation of the functions, purposes and advantages of my baffle wall. Suffice it to say for the present, that the wooden baffle walls are not satisfactory and have simply been used for lack of something better.

Referring now to the preferred form of my baffle wall, as shown in the drawings, I have used the reference numeral 10 to indicate generally the central member of my baffle wall, which consists of a vertical, semi-cylindrical element. This element I preferably make of galvanized iron, but it will, of course, be understood that it can be made of a variety of materials and that any material suitable for the purpose can be used.

Connected with each side edge of the central member 10 is an end member 11. The members 11 are preferably substantially semi-cylindrical as shown for instance in Figure 2, opening in the opposite direction from the opening of the member 10.

When the baffle wall is installed in the ditch, the central member opens downwardly with relation to the water flow and the members 11 open upwardly, as illustrated.

It may, of course, be mentioned that the degree of curvature of the members 10 and 11 may be varied, and it would be possible to use other shapes to accomplish generally my purpose.

The members 10 and 11 are preferably provided with horizontal corrugations 12, which might have the form of ribs, shoulders or otherwise to accomplish the functions of such corrugations hereinafter more fully explained.

The baffle walls herein described are set in the ditch with the member 10 at the center of the ditch at the bottom thereof and the members 11 embedded in the side walls. The height and width of the members 10 and 11 will, of course, vary according to the service to be required of the baffle wall.

For purposes of illustration, I might say that in an ordinary ditch eighteen inches wide at the bottom, I make the member 10 approximately four feet in height and vary its shape from a half circle in horizontal section, so that the distance from side edge to side edge is substantially two feet, and in the particular size of baffle wall now being used for illustration, the height of the central member from top to bottom is four feet.

In the particular wall now under consideration, the members 11 are also two feet on a straight line from side edge to side edge and four feet around the curve of the member from side edge to side edge.

In Figure 1, I have shown the members 11 projecting above the member 10 at their edges adjacent thereto approximately four inches and have shown the upper edges of the members 11 inclined upwardly from their inner edges to their outer edges, so that the outer edge of the end member 11 stands about twelve inches above the member 10 and this angle of inclination may be varied as necessary for the particular job.

In the actual process of manufacture, where the device is made of galvanized sheet metal, I use sections so that each member 10 is made of two sections as illustrated in Figure 1, and each member 11 is made of two sections and a portion of the third section.

If a comparatively low baffle wall is necessary then only one section in height is required.

In Figure 8, I have shown a slightly modified form of the end members indicated by the number 11^a in which a portion indicated at A is cut off the bottom of the end member and is secured to the upper section of the end member to form that portion of the end member which projects above the level of the central member. Where conditions will permit this structure, it effects a substantial saving of material.

It will be understood that the height of the end members above the central member will vary according to the service required of the baffle wall.

In Figure 3, I have shown a section of a ditch in order to illustrate the arrangement of two of the baffle walls with relation to each other. In actual practice, I prefer to install baffle walls in the ditch with the upper edge of the member 10 substantially level with the bottom of the ditch above the baffle wall and with the bottom of the ditch approximately two feet below the top of the member 10 below the baffle wall.

The side members 11 are practically entirely banked and covered with dirt on the up-side portion of the ditch, the outline of the ditch being indicated by the dotted line 13 in Figure 1. The outline of the ditch on the downside of the baffle wall is indicated generally by the dotted line 14 in Figure 1.

In the bottom of the ditch where the water falls over the member 10 something better than a dirt bottom may be provided. In Figure 3, I have shown a pile of stones 15. Any bottom, which will reduce washing to a minimum may be employed. The bottom of the ditch from baffle wall to baffle wall may be inclined or sloped slightly as shown in Figure 3 depending on soil conditions.

In Figure 9, I have shown another slightly modified form of my invention, which might be desirable to be employed under special circumstances, as for instance where the walls might be installed in a ditch that had washed badly.

In the form shown in Figure 9, I have shown connected with the outer portions

of the members 11 curved wings 16, which may be made of a portion of material similar to the members 11, but are preferably lighter.

I will now explain some of the uses and advantages of my improved baffle wall.

It will be understood that the general purpose of a baffle wall and drainage ditch is to control the flow of water and reduce washing of the ditch. This is accomplished by baffle walls by virtue of reducing the velocity and momentum of the flow of water. This reduction is accomplished by causing the water to flow over the baffle walls with a drop and then to flow from one baffle wall to another in a ditch having a comparatively slight slope instead of permitting the water to flow down in a long ditch having a greater slope.

There is then involved the problem of providing the most efficient baffle wall for accomplishing the purpose of reducing the velocity and momentum of the water with a minimum washing of the ditch at the point where the baffle wall is installed.

These general purposes I have provided for in the structure, arrangement and installation of my baffle wall.

Referring now to the straight walls heretofore used, it may be mentioned that when such walls are employed, the water flows from the up-side of the wall into the portion of the ditch on the down-side of the wall with a substantial fall of for instance two feet. The falling water washes a hole below the wall and the water usually forms an island a little farther down the ditch. Even after the high water goes down and the flow of the water is substantially reduced, the island will tend to divert the flow of water in the ditch and will cause the water to eat into the sides of the ditch which is an undesirable result. The island directs the water below the baffle wall outwardly against the side walls of the ditch frequently causing a bad washing of the ditch wall at that point. This undesirable result is prevented where my wall is employed by reason of the fact that the water instead of flowing over an eighteen inch or even a twenty-four inch straight wall, as in the case where a straight wall is employed, flows over a curved wall four feet in length and the water does not fall over a straight wall and then down but over a curved wall, so that the water flowing in from the side mingles with the water flowing over the central portion of the central member 10 with the result that in actual practice, the force of the water is so controlled that the island mentioned does not form to anywhere nearly the same extent as where a straight wall is used. It may be mentioned that where rock or other solid bottom is placed in the member that no island will be formed, the solid bottom preventing the water from gouging out between the walls of the members 10 and 11.

Where a straight wall is employed, the churning of the water on the down-side of the wall washes out the side walls of the ditch along the lower face of the baffle wall and washes the dirt away from the baffle wall.

Where my structure is employed, the churning effect of the water in washing away the dirt of the ditch at the side of the ditch is prevented by the fact that the water falls into a channel protected at its sides by the curved wall of the member 10 and by the curved walls of the members 11.

I therefore practically do away with the washing of the side walls of the ditch immediately adjacent to the baffle wall on the down-side of the baffle wall.

Thus the ditch does not wash out close to the wall on the down side of the wall where my device is used to anywhere nearly so great a degree as where a straight wall is employed.

Furthermore, where a straight wall is employed, it will be remembered that during a rain, water travels down the sides of the ditch to the bottom of the ditch in little streams and rivulets. These little streams and rivulets come down to the straight wall and find there, for instance, the edge of a two inch plank surrounded by soft refill dirt. They begin to wash out the dirt to provide a path not only for the streamlets flowing down the side wall of the ditch but also for the main stream of water flowing down the ditch. When this occurs, the dirt at the end of the straight baffle wall is washed away very rapidly leaving the ends of the baffle wall exposed. Dirt is then washed away from the up-side of the baffle wall near the end, and oftentimes cut deep enough to permit the main channel of the stream to pass around the edge of the wall.

It thus frequently occurs in actual use of the straight walls that enough dirt is washed away from the down-side of the baffle wall so that the baffle wall begins to tilt forwardly from its upper position and in a very short time is washed entirely out.

I have already expained why the dirt will not wash away from the down-side of the central portion 10.

I will now explain why the dirt will not wash away from the outer edges of the members 11. It will be noted that if the distance from the point indicated by the arrow 17 in Figure 2 to the point indicated by the arrow at 18 in Figure 2, being substantially the radius of the circle on which the member 11 is formed, is approximately one foot, there is a wall of dirt a foot in length against the outer portion of the member 11, which must be washed away and

moved down-stream before water can begin to flow around the outer edge of the member 11.

In actual practice, I find that the little rivulets flowing down the side wall of the ditch toward the member 11 do not move this foot of soil, because of its weight and inertia, but these little rivulets tend to flow up-stream from the member 11 or down-stream from the member 11, thus forming a ridge up the side wall of the ditch from the outer portion of the member 11.

It follows, of course, that the little rivulets avoid this ridge and flow down at the sides thereof, so that the ridge remains to protect the outer edge of the member 11 and the dirt at the outer edge of the member 11 does not wash out.

It has already been noted that owing to the fact that the water flowing over the member 10 flows not only in a direction down stream, but also towards the center of the stream on account of the curvature of the member 11, the earth on the down-side of the member 11 is not washed away on the down-side of the member 11 as in the case of a straight wall.

This fact combined with the facts already mentioned that the earth does not wash away at the outer edges of the members 11 on account of the peculiar structure of my wall permits my wall to remain firmly and rigidly installed in position where a straight wall would have washed out.

In this connection, it will be noted that in bad places, the wing 16, such as is shown in Figure 9, increases the functional operation of the outer portions of the members 11 in preventing the washing away of dirt around the ends of the baffle wall.

It will be noted also with the curved form of wall herein shown, it would be necessary in order to wash out enough dirt to permit the wall to tilt forwardly at its upper portion and then wash out to move a great deal more dirt than would have to be moved to permit a straight wall to tilt down-stream.

It will, therefore, be noted that my baffle wall as herein shown draws the water away from the bank side walls at the point where the maximum flow occurs over the member 10, thus reducing the wash on the side walls of the ditch. It permits the water to flow into a protected channel and thus protects the side walls of the ditch. It prevents washing of the side wall of the ditch away around the ends of the baffle wall.

It follows that my baffle walls do not have to be re-placed frequently as is the case of straight walls and the cost of the repair and upkeep of the ditch is thus substantially reduced.

It will be noted that with the curved member 10 the water flows over a wall four feet in length and the capacity of the ditch is thus substantially increased without the widening of the ditch and lengthening of the wall.

The velocity and momentum is thus reduced as compared with the use of the straight wall without increasing the width of the ditch.

This increase of capacity is very important resultant from the use of my wall, since it makes it possible for the ditch to take care of a greater volume of water with a minimum of wash.

Another feature of my structure, which contributes to the permanence of the structure and helps to prevent washing out around the structure and thus reduces the cost of upkeep of the ditch is found in the corrugations or their equivalents.

It is obvious that if the dirt on the down-side of the baffle wall should wash out part way down the wall from the top to the bottom, so as to subject the wall to the pressure of the water, and more important the pressure of the dirt on the up-side of the wall, so that there might be a tendency on the part of the baffle wall to tilt forwardly and downwardly, the corrugations form anchors in the dirt in which they are embedded to prevent this tilting. This anchoring effect is increased by the curved form or the equivalent thereof of the baffle wall.

For instance, it will be noted that pressure of the dirt on the wall tends to push the upper part of the wall down stream and this tendency is resisted by the corrugations of the lower part of the wall and the side members 11 of the wall, which thus serve as anchors.

It will, also, be noted that the curved form of the wall tends to resist any pressure which would be likely to tilt the wall down-stream.

It will be obvious that the distance from a transverse line extending through the centers of the members 11 to a transverse line across the ditch to the centers of the members 11 is substantially two feet and there is thus provided a two foot base for the baffle, instead of for example a two inch base of a straight plank wall.

Another advantage arising from the corrugations will now be referred to.

After there has been a considerable flow of water following a rain or in the wet season, and the ditch dries out, it is well-known that the surface of the earth shrinks.

In Figure 5, I have illustrated by the dotted lines 19 the position of the soil on the up-stream side of the central member 10 when the ground is wet. In full lines at 20, there is shown the position of the soil or earth after the drying out and shrinkages has occurred.

It will be noted that the earth close to the members 10 and 11 shrinks away from the

members 10 and 11 up-stream and also drops downwardly slightly. Thus there is left an opening between the earth and the upper part of the baffle wall.

Where a straight wall is employed, this opening extends downwardly for a considerable distance.

Where my wall is employed it extends downwardly only to the first corrugation or rib on the up-stream side of the wall.

Thus where a straight wall is employed, this opening indicated by the numeral 21 will fill up with dirt and leaves blowing in by the wind, and when another flow of water occurs, the water will carry fine dirt, pebbles and so forth into this opening 21 before the dirt swells again, so that when the earth on the up-stream side of the wall becomes saturated with water, there is more dirt on the up-stream side of the wall than was there when the drying up process began and the swell and expanding of the dirt on the up-stream side when the dirt becomes thus again saturated, exercises a tremendous force tending to tilt the upper part of the wall down-stream. This is one of the factors that contributes to the tilting of the straight wall and its ultimate washing out.

I have observed in numerous instances in the case of the use of straight walls that this opening formed on the up-stream side of the wall by the drying out of the soil extends downwardly so far that when another rain occurs and water flowing in the ditch travels downwardly into this opening so far that it finds a way out around the end of the wall, thus contributing to the washing out of the dirt at the end of the wall. The objection just mentioned is very apparent when there is a light rain after a period of drought because the light rain does not carry much soil with it and there is no tendency to fill up the opening as would be the case with a real heavy rain.

Where my structure with the corrugations and ribs is employed, it will be obvious that the opening 21 extends downwardly from the surface of the bottom of the ditch only a very short distance and therefore only a very small amount of new dirt can be blown or washed into the opening, and hence when the swell or expansion due to subsequent saturation occurs, there is not such an exertion of pressure tending to tilt the baffle wall down stream and less chance of the water working around the baffle wall.

Thus again, I have a feature of structure which contributes to the permanence of my baffle wall and reduces the cost of upkeep and repair of the ditch.

The use of a better material than wood, such as galvanized iron or concrete or otherwise, which can be employed in my baffle wall, or course, increases the length of the life of the baffle wall.

Where my wall is made of galvanized iron, and it is found necessary to remove the wall for any purpose, the earth can be removed around the upper part of the wall and clamps applied and the wall pulled out substantially integral. This is absolutely impossible with the wooden wall that has been installed for any length of time.

It is almost impossible to remove a wooden wall that has been installed for any substantial time without such injury to the wall as to make it useless for a later installation.

It will be obvious from the foregoing that changes may be made in the details of the construction and arrangement of the various parts of my improved baffle wall without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

It is my intention to cover by the words "channel-shaped" and "substantially corrugated" in my claims any structure or shape, which would be equivalent of the forms shown in the drawings for the purpose of performing the desired functions.

I claim as my invention:

1. A baffle wall of the class described, comprising a central channel-shaped member, and channel-shaped oppositely opening end members, said members having horizontal corrugations of substantial depth on their upstream sides.

2. A baffle wall of the class described, comprising a central channel-shaped member, and channel shaped oppositely opening end members, said end members having wings inclined away therefrom substantially inclined parallel with the stream line of the ditch in which the wall is installed.

3. A baffle wall of the class described, comprising a central channel-shaped member and oppositely opening channel-shaped end members, having their upper edges higher than the central member and inclined upwardly and outwardly.

Des Moines, Iowa, October 20, 1923.

EMIL BERN.