No. 607,215.

Patented July 12, 1898.

W. W. CARSON.

RIPRAP.

(Application filed Jan. 31, 1898.)

(No Model.)

2 Sheets—Sheet 1.

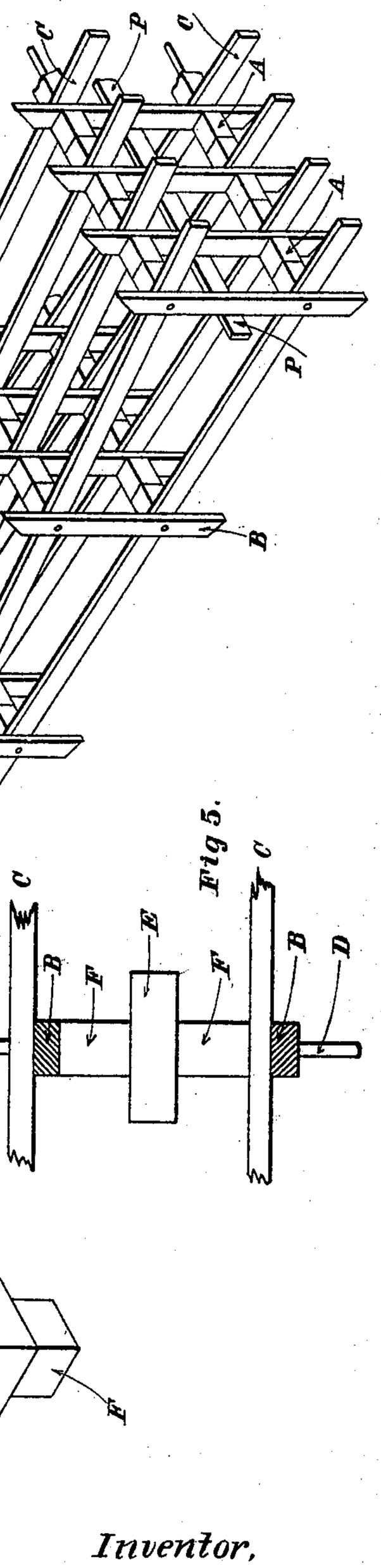


Fig 3.

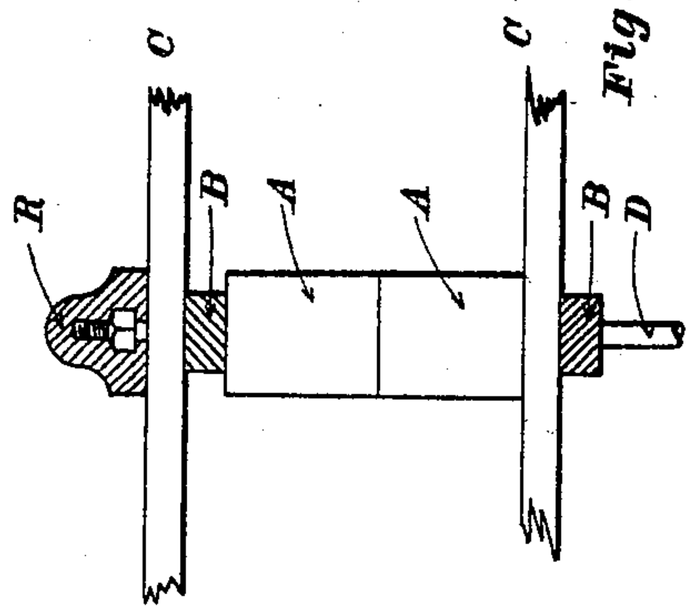


Fig 2.

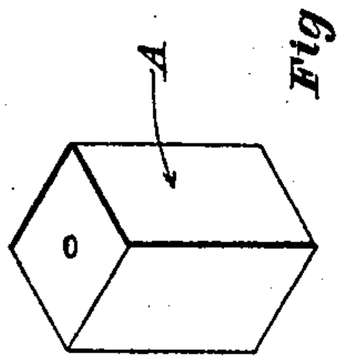


Fig 1.

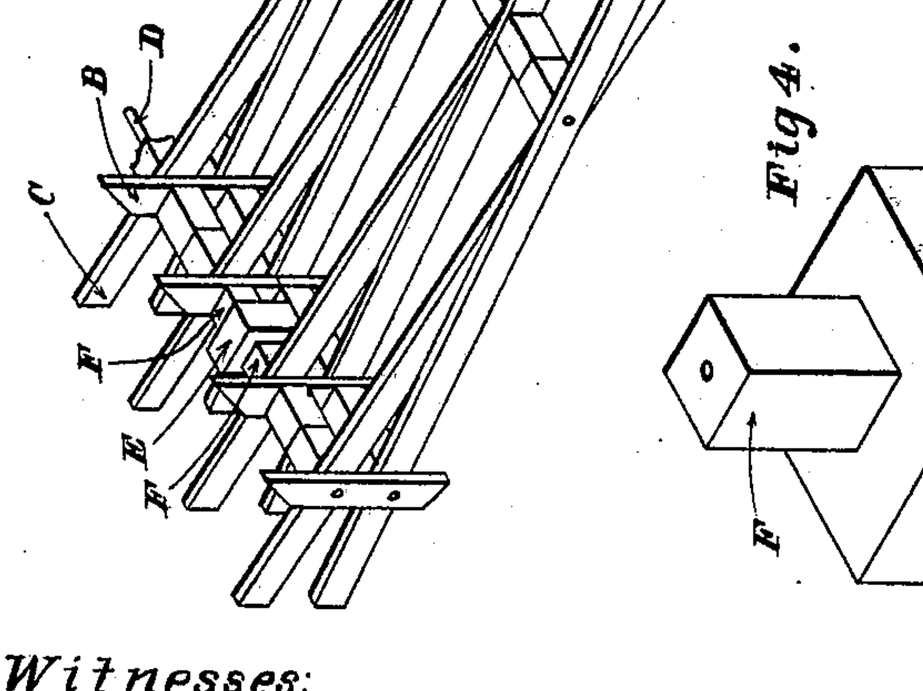
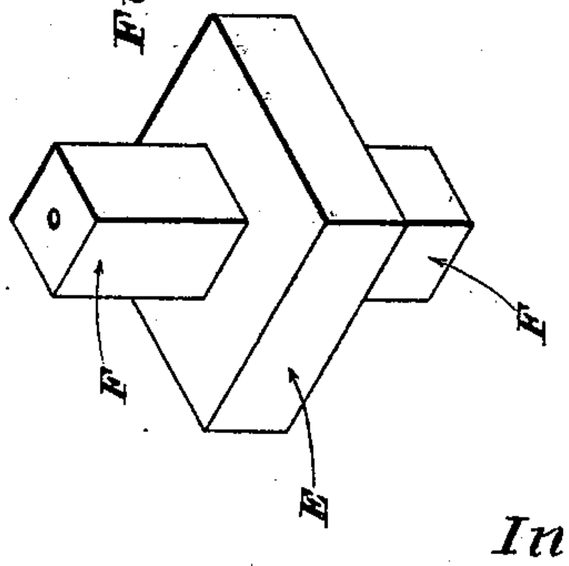


Fig 5.

Fig 4.



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No. 607,215. Patented July 12, 1898.

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RIPRAP.

(Application filed Jan. 31, 1898.)

(No Model.) 2 Sheets—Sheet 2.

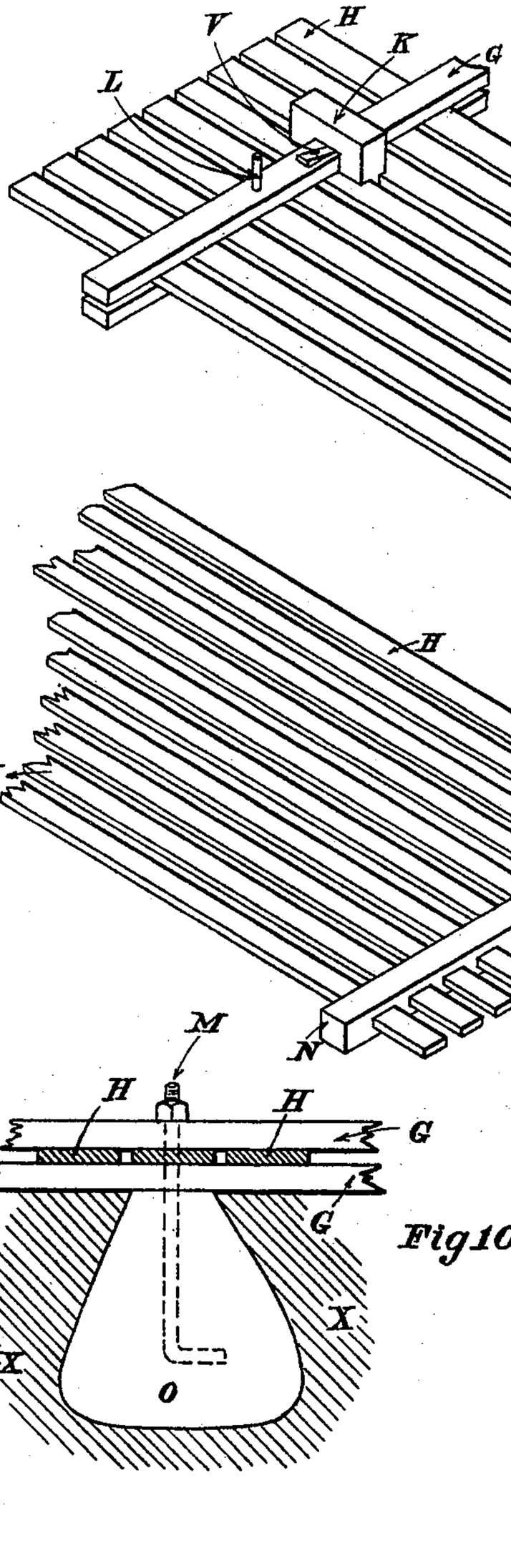

Fig 6.

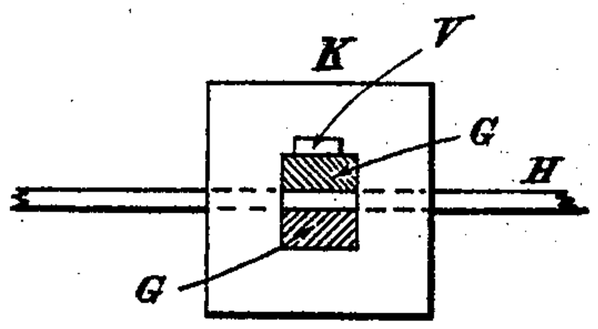

Fig 7.

Fig 8.

Fig 9.

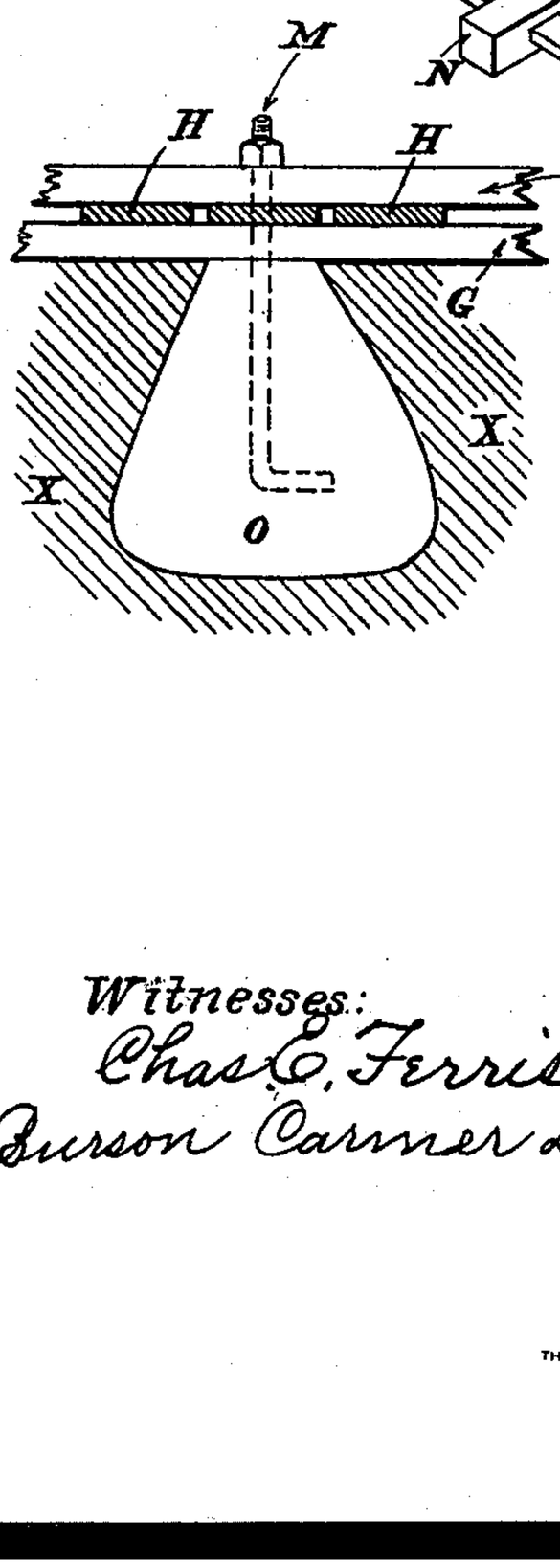

Fig 10.

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UNITED STATES PATENT OFFICE.

WILLIAM WALLER CARSON, OF KNOXVILLE, TENNESSEE.

RIPRAP.

SPECIFICATION forming part of Letters Patent No. 607,215, dated July 12, 1898.

Application filed January 31, 1898. Serial No. 668,639. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM WALLER CARSON, a citizen of the United States, residing at Knoxville, in the county of Knox and State of Tennessee, have invented a new and useful Improvement in Ripraps; and I do declare that the following is a full and clear description of my invention, which will enable others skilled in the art to which it appertains to make and use the same.

The principal use of riprap is to protect the shore or bed of a stream, lake, or ocean from scour. It may act mainly by breaking or deflecting the waves or currents, or it may act mainly by retarding them. Natural riprap—that is, stone—is nearly always used when the action is to be of the first kind, provided the stone can be had at low enough cost; but when stone is costly or when to induce action of the second kind the riprap must be of special shapes resort must be had to artificial riprap. This last has played but a small part in the engineering history of the world, for in the very nature of the case artificial riprap must in most cases be made largely of wood, since no other known material able to resist waves and currents compares with it in cheapness and in the facility with which it may be worked into desired shapes; but for the reasons given a few lines farther on the effort to use wooden riprap has only met with success in exceptional cases, and so the engineering profession has been so seriously hampered in some places by the lack of a riprap sufficiently cheap, in others by the lack of a riprap suitable as to form and size of its unit-pieces, that great engineering problems otherwise possible remain unsolved as yet. This is notably true in the matter of river control.

In order to use wood as a riprap, a sinker is needed, and the great hindrance to the use of wood as a riprap, and hence to the filling of this deep-seated engineering want, is the fact that the world has not hitherto had a suitable method of applying the sinker. One method of applying the sinking substance is to place it loose upon the wooden structure. Obviously this method is limited to shallow water or to structures of large area, such as a mat made of brush or poles. The method is wasteful, for the sinking substance serves as a sinker only and contributes nothing to the strength or shape of the wooden structure, and there is reason to believe that the destruction of many mats has resulted from the shifting of the sinkers, the shifting being due sometimes to the tilting of the mat while being sunk, sometimes to the fact that the mat rested here and there on slopes too steep originally, and sometimes to the fact that the slope was subsequently made too steep in places by a local flow of earth beneath the mat. It will be seen farther on that my invention overcomes these difficulties, for I carefully determine beforehand the size and place for each sinker, and I make the sinkers of such shape and firmly attach them to the structure in such manner as to aid in giving the latter form and strength. Moreover, my method of attachment is cheaper than the methods heretofore used and free from at least one of the objections shown below to inhere to them. In cases where the sinking substance is not placed loose upon the structure the general practice is to incase it in crates or internal pockets built in the structure itself. As profusion in use, which is dependent on cheapness, is one of the underlying ideas of riprap, it is plain that there can be no general use of artificial riprap until some cheaper way of applying the sinker than that of crating it is devised. Moreover, the crates themselves induce whirls and scour and so it is scarcely possible to make a good design for riprap, especially for one to protect by a gentle and cumulative retardation of the current, without first devising a better method of attaching the sinking substance than the present one of crating it. Abundant proof of the correctness of this conclusion may be seen in the fact that almost the sole examples in practice of the method of attaching the sinking substance by placing it in crates or pockets are to be seen in cribs, caissons, and spur-dikes, and even these are generally too large and on account of their cost are used too sparingly to be classed with what commonly goes by the name of "riprap."

The general ideas calling for my invention and met by it may now be summarized as follows:

First. In order to minimize the damage done to a riprap by a local flow of earth, the former should not be made in large continuous

areas, (as mats are now made,) but in unit-pieces, each complete and stable in itself. Thus a local flow of earth would bring only local damage to the riprap.

Second. The sinking substance for each unit-piece should be firmly fastened to it, but not by crating.

Third. The sinking substance should aid in holding other members of the unit-piece in relative position, so as to save, as far as possible, the cost of providing special members for this service.

Fourth. For service between the levels of high and low water, as will appear more fully farther on, the design of the unit-piece should be such as to allow the wooden members to be removed and replaced alternately and repeatedly without disturbing the position of the sinkers.

Fifth. A unit in order to facilitate placing, especially if the current is swift, should sink quickly and without sailing or swaying back and forth. Hence it should go down endwise and, revolving about the end first striking bottom, should be laid out by the current, and this upstream end, as it has now become, should be heavy to prevent rolling. For these two reasons the sinkers should be applied largely near one end.

Sixth. It is evident that the second and third require the sinking substance to be worked to designed forms or features.

In carrying my invention into effect I am of course governed in each individual case by what I wish to accomplish, how I wish to accomplish it, and by the peculiarities of the case itself. These determine the size and style of the unit-pieces of the riprap, the number of unit-pieces to be placed on a given area, and the manner of placing them. True economy often requires that risks be taken, as it is often cheaper to rebuild in places than to insure stability at every point, and so I do not always cover the whole of the exposed area. Sometimes I place the unit-pieces of the riprap more or less separate the one from the others. Sometimes I cover certain areas by compact groups of unit-pieces and leave intervening areas bare. It will generally be preferable, but by no means always necessary, in cases where the protection is to be of this intermittent type or where there is reason to suspect that a local flow of earth may cut a swath through the mass of riprap and so reduce the protection to the intermittent type to use a form of riprap that will act mainly by retarding the current. For such service the unit-piece should be an open framework. The particular pattern of framework is largely a matter of personal taste. My own preference is for such a design as is shown in Figure 1 of the accompanying drawings; but I use several times as many bents to the frame as are shown in the drawings; but in shallow water the frames would sometimes be objectionable on account of their liability to be struck by passing boats and driftwood. Again, for the protection of the zone between the levels of high and low water on streams which rise only once or twice a year it is highly desirable that the riprap shall be of a style which will allow (more easily than the frames would do) its wooden members to be taken out and sheltered from the weather and again replaced when needed. In these cases, just as in the first case, the particular pattern of the unit-piece is largely a matter of personal taste. My own preference, for use in shallow water, is for such a pattern as is shown in Fig. 6 of the accompanying drawings, and for the zone between high and low water my preference is for such a pattern as is shown in Fig. 8 or in Fig. 10.

The accompanying drawings, already referred to, consist of two sheets.

Fig. 1 shows part of such a frame as I have already said I have a personal preference for for general use. B B are the posts. C C are the stringers. A A are combined sinkers and spacers, preferably of brick or concrete. E is a denser sinker, preferably of metal. D D are rods upon which the posts, stringers, spacers, and sinkers are strung and so connected together. P shows one of a number of planks or slats which I sometimes add to aid in retarding the current.

Fig. 2, representing a block A with a hole through it, shows, to a larger scale, the form in which I make a brick or concrete sinker when it is to serve also as a spacer.

Fig. 3 shows, likewise to a larger scale, how I string the posts B, stringers C, and the combined sinkers and spacers A on the rods D. It also shows that I sometimes mold a cap R, of asphalt or other waterproof material, around the nuts on the ends of the rods D.

Fig. 4 shows a non-metallic separator F, which I use to prevent contact of metals when a metal sinker E is to be strung upon a bolt, rod, or other metal member.

Fig. 5 shows the metal sinker E with its non-metallic separator F strung upon the metal rod D, the separator serving also in this case as a spacer.

Fig. 6 shows the style of unit-piece for riprap which I prefer for use in shallow water. H H are planks or scantlings passing between scantlings G G, which in turn pass through metal sinkers K K and are clamped by wedges V V. Wooden pins L L, which may be long enough to stick into the bed of the stream, so as to make sliding on the bottom more difficult, aid in holding the structure together.

Fig. 7 gives a side view of a sinker K, with a sectional view of the scantlings G G and wedge V.

Fig. 8 shows a pattern of unit-piece I often use between the levels of high and low water. N is a sinker, preferably of metal or concrete. H H are wooden members which may readily be slipped out and put under shelter when the water falls.

Fig. 9 shows how I sometimes strengthen a concrete sinker N by metal rods or straps U U.

Fig. 10 shows by a partly-sectional end view of a unit-piece how I apply the sinker in still another way. G G and H H are the wooden members, as shown in Fig. 6. O is the sinker, or "anchor," as it might be called if buried in the earth X, as shown. M is a bolt and nut or other connection easy to detach. Thus when the flood subsides the sinker may be left in place and the wooden structure removed as a whole and sheltered from the weather.

Having thus explained the drawings, I proceed to explain more fully how I carry my invention into effect. If I select an open frame, as shown in Fig. 1, I generally use two-by-four-inch lumber. I place the posts B about seven feet apart, measured along the stringer C, making the shortest post about three feet long and the longest about seven feet. No matter what style of unit-piece I use, except where excessive cost or manifest harm would result, I make sliding more difficult by causing one or more edges, ends, or points to project, so as to indent the bed of the stream. Thus in these frames I cause the posts B to project, and I generally sharpen their ends, as shown. I generally make the stringers C from thirty to sixty feet long, building them, when cheaper, of several pieces of lumber. I place the bents from one to four feet apart and use enough of them to make the frame about thirty feet wide. In order to make my meaning easier to understand, I will here remark that the part of the frame which I call a "bent" has its plane at right angles to the rods D. Thus each of the four bents shown in Fig. 1 consists of a pair of intersecting stringers C and the series of posts B adjacent thereto. For the rods D, I generally use round iron one inch in diameter. For sinkers I generally use brick or concrete or other cheap and heavy substance capable of being fashioned according to design; but in order to induce the frame to sink small end foremost (when thrown overboard from a boat) I weight that end most heavily. To do this, I place larger sinkers or string additional sinkers on the posts and stringers near that end; but generally I simply place in that part of the structure a few sinkers E of greater density, preferably of cast-iron. Whenever possible, I interpose a non-metallic separator to prevent the contact of two metals and the more rapid oxidation that would result therefrom. I sometimes increase the retarding effect of a frame on the current by adding a few planks, as shown at P in Fig. 1. I make the frames, as, indeed, I make all other unit-pieces to be used in deep water, with tops and bottoms as nearly alike as possible, since either side may turn uppermost in sinking.

When the water is shallow or when for any reason I desire a riprap that will not project much above the bottom, I generally select the style of unit shown in Fig. 6. I build this of planks, say, one by six inches by twenty feet, placed from one to three inches apart, passed between and held together by pairs of scantlings, which in turn are passed through sinkers K—say of cast-iron and weighing one hundred pounds each. I place most of the sinkers near one end to cause that end to sink foremost and to prevent it from being raised by the current after it has taken position on the bottom as the upstream end; but the full description which I have already given in connection with the drawings, both as to this and as to the other styles of unit-pieces shown, makes further description superfluous.

In laying riprap in deep water it is generally cheaper to use an excess of unit-pieces than to place them carefully where wanted. So generally in such cases (and speaking now of the frames of Fig. 1) I simply cast them overboard from a boat with rods D at right angles to the current. I of course determine their final positions, as far as may be convenient, by having the boat in proper positions at time of casting them overboard, estimating of course their probable drift. The small end being weighted most heavily strikes bottom first, and the frame, carried forward by the current, revolves about that end until it finally lies along the bottom with stringers C approximately parallel to the current. When the current is tolerably uniform and when I drop overboard just the number of frames needed to cover the given area, they no doubt lie on the bottom with considerable regularity. In other cases they without doubt drift and pile more or less upon each other. This of course means bare places here and there; but the mat of slats, stringers, posts, and spacers, whether a uniform covering or a tangled mass, retards the current and so protects not only the areas actually covered, but uncovered areas in the vicinity, upstream as well as down. This is one of the great advantages possessed by this style of riprap, for when a flow of earth (such as has so often brought destruction to the brush mats on our Western rivers) cuts a swath through the mass of riprap the surviving portions protect the area thus laid bare. In a similar way I place unit-pieces of other styles when I lay them in deep water. When the water is shallow or absent, I of course place them accurately where I want them. In such cases my habit is to lay such a unit as is shown in Figs. 6 or 8 with its heavy end upstream and overlaid by the lighter end of its upstream neighbor, after the manner of a shingle roof. In using such units in deep water I sometimes throw them overboard in much greater numbers than would suffice to cover the given area.

I often protect the metal, especially the wrought-iron, that may be used by one or other of the well-known coatings or protection processes. I do not claim novelty for the cap R (shown in Fig. 3) over the nut on the end of the rod D on the ground that it is a waterproof covering. I am aware that wa-

terproof coverings are put on daily both with a brush and by immersion. What I claim as novel is the use of a cap put on by molding.

It is evident that in Fig. 10 a mass of wood or other light substance, if buried in the earth X, might be substituted for the sinker O; but this construction would be but a particular application of my invention, as is readily seen by regarding the earth as the sinker. It only remains to add that my invention, whose central idea is that of an external sinker fashioned according to design, furnishes a riprap superior to all others in river-work where it is necessary to prevent a bank from caving, a bed from scouring, a levee from washing, a crevasse from widening or deepening, in narrowing a channel, closing a chute, directing the flow, &c. It may also be used to reduce the discharge through a crevasse and may even aid in closing the break in the levee. It may also be used for submerged sills.

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

1. A riprap made largely of sawed lumber and composed of unit-pieces, each of which is definite in design, complete in itself, and is weighted by one or more sinkers of definite design attached externally.

2. A unit-piece of definite design, for a riprap largely of wood, in which one or more planks, scantlings, rods or bars pass through one or more sinkers.

3. A riprap made of open frames constructed largely of sawed lumber and weighted by external sinkers made with one or more eyes or slots to facilitate attachment.

4. A riprap, constructed largely of sawed lumber, in which external sinkers, shaped according to design, are attached to the unit-pieces in such manner as to determine, with more or less room for play, spacings and directions of the wooden members.

5. A riprap, constructed largely of sawed lumber, in which external sinkers, fashioned according to design, are attached to the unit-pieces in such manner as to determine, with more or less room for play, spacings of the wooden members.

6. A wooden riprap with unit-pieces most heavily weighted at or near one end.

7. A unit-piece for a riprap, largely of wood, weighted externally and having projecting members to indent the bottom of the stream so as to make sliding more difficult.

8. A unit-piece for a riprap, largely of wood, weighted externally and having pointed projections to aid in preventing sliding on the bottom.

9. In a wooden riprap, a unit-piece, with external sinkers, constructed with bottom and top practically alike, so that whether the one or the other turns uppermost in sinking the same action and manner of action will result.

10. A unit-piece, for a wooden riprap, with one or more detachable external sinkers.

11. In a riprap, largely of wood, a molded cap of waterproof material over the nut on the end of a metal rod, to prevent the more rapid oxidation that would otherwise result from contact of the metals in presence of water.

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Witnesses:
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