Dec. 1, 1942. W. P. DAY 2,303,335

METHOD OF EMPLACING CONCRETE

Filed Sept. 21, 1939 2 Sheets-Sheet 1

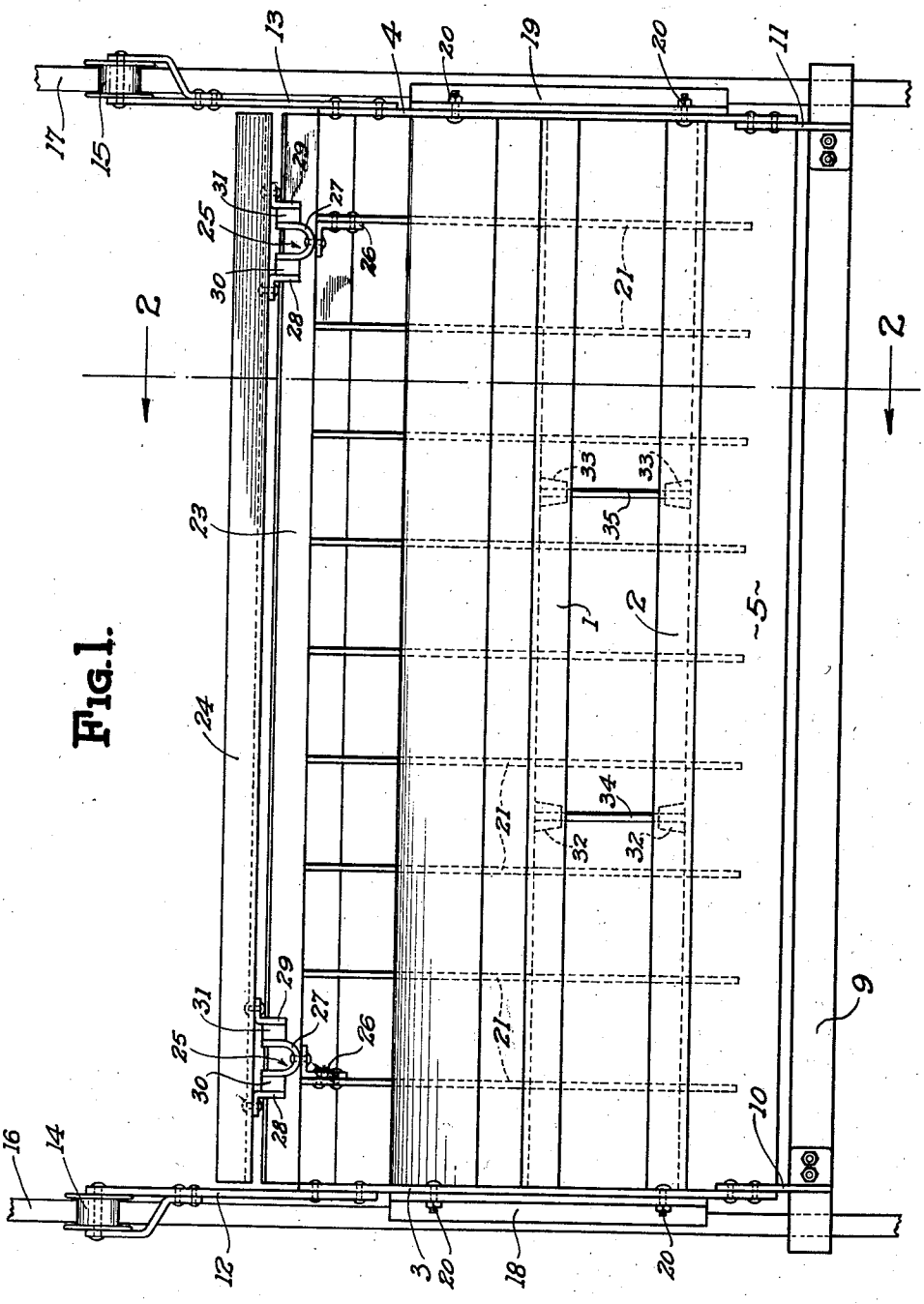


FIG. 1.

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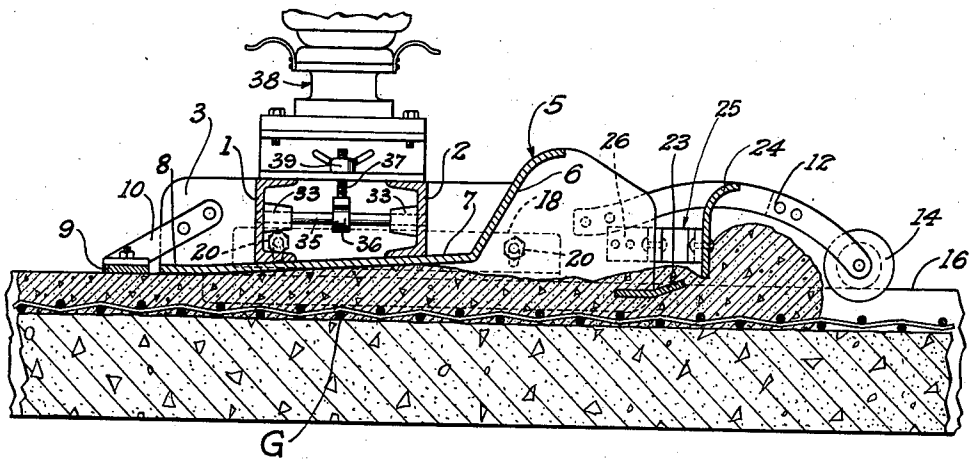


FIG. 2.

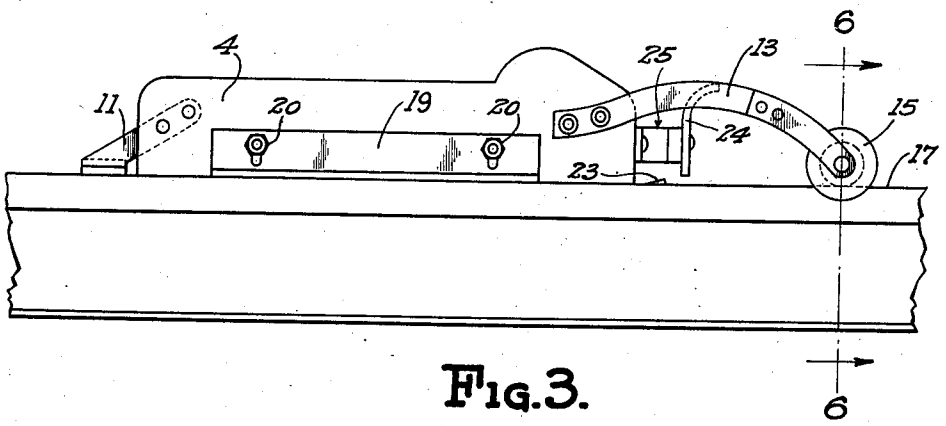


FIG. 3.

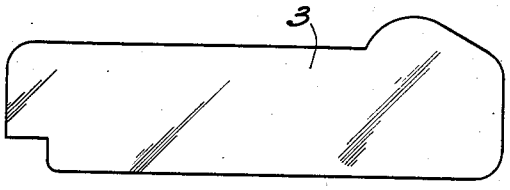


FIG. 4.

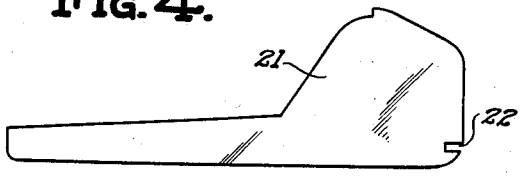


FIG. 5.

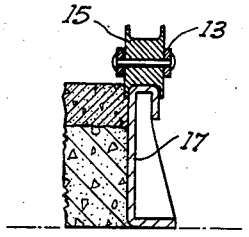


FIG. 6.

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UNITED STATES PATENT OFFICE

2,303,335

METHOD OF EMPLACING CONCRETE

William P. Day, Cleveland Heights, Ohio

Application September 21, 1939, Serial No. 295,944

3 Claims. (Cl. 94—24)

This invention relates to a method of laying or emplacing concrete which is particularly useful in connection with the laying of a sidewalk, road, street, highway or the like.

One of the objects of the invention is to provide a method and apparatus of laying a concrete road in which the tendency to crack or spall is reduced to a minimum.

A further object of the invention is to provide a method of laying a concrete road or the like which consists in first applying a layer of concrete of considerable thickness and before such layer has completely hardened or set, applying a surface layer thereto and, while such surface layer is still soft, imparting rapid and violent vibrations thereto to cause it to settle and bond with the first layer, such surface layer being sufficiently thin that there will be no appreciable amount of laitance at the top thereof.

Another object of the invention is to provide an apparatus which is particularly well adapted for practicing the method herein described and which comprises few parts, and which is rigid and dependable in construction and well adapted for production at a low cost.

A still further object of the invention is to provide an apparatus for vibrating concrete which is in the form of a vibratory screed having a plurality of plates rigidly secured thereto and projecting downwardly therefrom and which has a second screed or pressure plate which is rigidly secured to said plates and disposed in a plane below the first screed and shaped and disposed so as to provide a tapered and restricted passageway through which a part of the mix is caused to flow before it reaches the first screed, the second screed being shaped to provide a downwardly tapered passageway through which concrete is caused to flow, the inlet end of said passageway being of greater capacity than the outlet end thereof whereby the concrete will be subjected to a vibrating pressure.

It is well known that concrete and other hard surface roads frequently become cracked and spalled because of the fact that water seeps into the road and due to freezing and thawing action deterioration is caused. With my method and apparatus I am able to greatly reduce the tendency of the road to crack and spall and to lay a concrete road in which the strongest and best quality material is disposed at or adjacent the surface of the road and the entire road is of substantially the same consistency.

It is old in the art to vibrate concrete while it is still soft or plastic to cause the concrete to settle and to eliminate voids and air pockets. Such vibration has usually been carried out by means of a machine which imparts to the mass of soft concrete rapid and violent vibrations, the vibrations being of the order of 4,000 to 10,000 impulses per minute. Such vibration causes the lighter and less dense or more flowable part of the mixture to rise to the top as a result of which the surface or upper portion of the road contains the weakest and less desirable material while the heavier and better quality material tends to sink or to move downwardly, with the result that the surface of the road which should contain the best material and be the strongest part of the road is in fact the weakest. If there is an excess of water present, vibration will cause a mixture of the floury part of the cement and water to be brought to the surface and this forms a scum or thin layer of whitish material known as laitance. This laitance prevents the proper bonding of more concrete emplaced thereon and constitutes a plane of weakness. If this laitance can be eliminated or removed, much better results will be obtained. In fact, specifications frequently require that the layer of laitance be removed. Laitance, however, can only form from an excess amount of water which means that the upper portion of the road will be porous and the removal of a thin layer of laitance still leaves a layer of considerable thickness of porous concrete through which water will pass. The effect of this porous layer at the top of each day's work can be noticed particularly where an excess amount of water is used. The lower portion of the layer of concrete is found to be hard and dense while the upper portion is porous and weak.

In order to overcome this difficulty, I propose to first lay or emplace a layer of concrete of the desired consistency and of a depth of approximately one to two inches less than the desired depth of the finished road. This layer is allowed to partially harden and dry. I then apply to the road a thin surface layer preferably about one to two inches in thickness. This surface layer contains the strongest and best grade of materials and only has enough water to obtain the desired chemical action and workability. This surface layer may be applied to the road by means of the apparatus shown in my prior Patent No. 2,180,198, and of which this application is a continuation in part. Rapid and violent vibrations are imparted to this layer of material preferably in a plane generally parallel to the surface of the first layer. This surface layer should preferably

be applied before the first layer has completely hardened or set and before it has become dirty or coated with foreign matter. Due to the fact that this surface layer is very thin, there is very little tendency for the lighter and less dense particles to rise to the top. This surface layer also should contain the best quality material such as granite screenings or other suitable material.

When the method is used to apply a thin surface layer to the surface of an old road, the vibrations should be imparted to the surface of the old road as well as to the surface layer with the result that the surface layer will adhere to and firmly bond with the surface of the old road.

As a modification of my method I propose to lay or emplace the first layer of concrete as hereinbefore described. I then lay the reinforcing mesh or grid onto the first layer and apply the second or surface layer which has a depth somewhat greater than the thickness of the reinforcement. In some cases it may be desirable to lay the reinforcing grid or mesh on the first layer while it is still soft. The surface layer is then applied by being spread evenly over the first layer while applying rapid and violent vibrations thereto. The vibrations are preferably applied before the first layer has completely set and in such a manner that they will also be transmitted to the reinforcing mesh.

As a further modification of my method I propose to first lay and vibrate a layer of concrete of the desired depth by means of apparatus of the type shown in my Patent No. 2,180,198, filed November 22, 1938, or by the apparatus shown herein, and while such layer is still soft, I strike off the upper surface thereof to a sufficient depth to remove the laitance and undesirable material which has risen to the top as a result of the vibrations; then, after this layer has partially hardened, I cover the first layer with a thin second layer of concrete and form and compress the same while applying rapid and violent vibrations thereto. By this method the difficulties encountered because of the layer of laitance is overcome and the surface layer is caused to firmly bond with the first layer.

In the accompanying drawings I have disclosed an improved screed machine and vibrating apparatus for practicing the methods herein described and in which Fig. 1 is a top plan view of the machine supported upon suitable form boards with the vibratory unit removed so as to more clearly disclose the construction; Fig. 2 is a fragmentary vertical sectional view taken on the line 2—2 of Fig. 1; Fig. 3 is an end view of the machine; Fig. 4 is a detail view in elevation of one of the end plates of the machine; Fig. 5 is an end view similar to Fig. 4 disclosing one of the intermediate plates; and Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 3.

The machine consists essentially of a pair of metal channel members 1 and 2 which extend transversely and are connected together at their opposite ends by a pair of end plates 3 and 4 which are preferably welded thereto. Secured to the channel members 1 and 2 and extending transversely of the road is a metal plate indicated generally by the reference character 5 and which has a curved portion 6 at the front end thereof and an adjacent inclined portion 7 and a straight portion 8, the purpose of which will hereinafter appear. The plate 5 is preferably welded to the channel members 1 and 2 and to the end plates 3 and 4. Disposed rearwardly of the plate 5 and extending transversely of the machine is a strike-off bar which is secured to the end plates 3 and 4 by means of bars 10 and 11 which are secured in place by suitable bolts. Secured to the end plates 3 and 4 and projecting forwardly therefrom are a pair of curved arms 12 and 13 on which are rotatably mounted guide rollers 14 and 15 which are adapted to engage and roll upon the form boards 16 and 17, respectively. Secured to the end plates 3 and 4 and adjustably mounted thereon are a pair of brackets 18 and 19. These brackets are held in position by means of bolts 20 which engage in slots provided in the brackets.

Disposed intermediate the end plates 3 and 4 are a plurality of metal plates 21 which are shaped as shown most clearly in Fig. 5. Each of the plates 21 is welded to the plate 5 along its upper edge. Each plate 21 is also provided with a slot 22. Extending transversely of the machine and engaging in the slots 22 is a plate 23 which is shaped in section as shown most clearly in Fig. 2 and is welded to the plates 21 and the end plates 3 and 4. Also extending transversely of the machine is a cut-off plate 24 which is shaped in section as shown most clearly in Fig. 2. The plate 24 is adjustably mounted and secured to two or more of the plates 21 by means of the clips or brackets 25 which are known to the trade as vibration dampeners. Each of these vibration dampeners consists of a bracket 26 to which is secured a U-shaped clip 27 which is secured to the bracket 26 by suitable bolts. Secured to each side of the clip 27 are a pair of brackets 28 and 29 which in turn are secured to the plate 24 by suitable bolts. The brackets 28 and 29 are insulated from the U-shaped clip 27 by means of rubber blocks 30 and 31 which are vulcanized to the brackets 28 and 29 and to the U-shaped clip 27 with the result that the vibration of the machine will not be transmitted to the cut-off plate 24 to any substantial extent.

Secured to the channel members 1 and 2 are two pairs of bosses indicated by the reference characters 32 and 33. Extending through the channel members 1 and 2 and through the bosses 32 and 33 are a pair of pins or rods 34 and 35. Each of the pins 35 receives thereover an eye 36 which has an extended threaded portion 37. The reference character 38 designates generally a vibrator unit of the type shown in my copending application hereinbefore referred to. This vibrator unit is detachably secured to the machine so as to be readily removable therefrom. The threaded extensions 37 extend through overhanging portions provided on the vibrator unit and receive thereover wing nuts 39 for securing the same in place. The screed machine is shaped transversely to fit the contour of the road.

The machine is particularly well adapted for applying a surface layer to the surface of an old road or for applying a wearing top to a new road. When it is edsired to use the apparatus and method to apply a thin coating to the surface of a concrete road which has become defective, the defective road surface is first scarified and cleaned. In the use of the machine, a mass of concrete is spread in front of the machine to a depth somewhat greater than the desired depth of the finished layer. The machine is then moved forward slowly, the vibrator unit being operated to impart rapid and violent vibrations thereto. The plate 24 acts as a cut-off and the concrete passes thereunder and comes in contact with the screed or pressure plate 23 which is slightly tapered and subjects a part of the mix to a preliminary vibration and compression. After the

concrete passes beyond the screed 23 it comes in contact with the inclined surface 7 of the plate 5 which is also being subjected to rapid and violent vibrations. The concrete then passes beneath the straight portion 8 of the plates 5 where it is subjected to further vibration and compression. The strike-off bar 9 is merely a finishing screed which imparts a finish to the surface of the concrete. The reference character G designates a grid or reinforcing mesh which may be applied to the surface of the first layer of concrete, if desired. It is preferable to use a very stiff mix, that is a mix having very little water in excess of that necessary to insure the proper chemical action and workability.

A road formed according to the method herein described and having an eight inch bottom layer of standard slag concrete and a two inch surface layer of the same mix vibrated in the manner herein described was found to have an extremely hard surface or wearing top after curing for only seven days. It was found that it required fifty-one minutes to cut out a single standard core as against about ten minutes required in the usual road construction. It required forty-one minutes to cut through the two inch surface layer thus showing the high density and hardness of the surface layer. It was also found that the bit used to cut out the core was unfit for further use after cutting a single core whereas in the usual road construction a bit may be used to cut eight to ten cores. The bond between the lower layer and the surface layer was also found to be exceptionally good and no line of cleavage between the two layers could be discerned.

It is of course to be undesrtood that the methods herein claimed can be practiced by the use of different apparatus than that referred to or disclosed herein. Various changes may also be made in the apparatus herein disclosed without departing from the spirit of my invention. The invention is therefore limited only in accordance with the scope of the appended claims.

Having thus described my invention, what I claim is:

1. The method of forming a concrete road or the like which comprises the steps of first laying a layer of concrete mix of the desired depth and consistency and applying rapid and violent vibrations thereto and then before such first layer has completely hardened and set applying thereto a thin surface layer of concrete mix and reducing the water content of such surface layer by compressing and forming the same in situ while applying rapid and violent vibrations thereto whereby to cause such surface layer to adhere to and to firmly bond with said first layer without causing any substantial separation of the aggregate, such surface layer containing particles of aggregate which provide a dense and hard wearing surface.

2. The method of emplacing concrete pavement which comprises the steps of first laying a relatively thick bottom layer of concrete of slightly less depth than the desired depth of the finished pavement and applying rapid and violent vibrations thereto, then applying a reinforcing mesh to the top of said bottom layer, then, before such bottom layer has set, applying a surface layer and simultaneously applying rapid and violent vibrations thereto to cause the top layer to firmly bond with said bottom layer and reinforcing mesh, both of such layers of mix containing only a small amount of water in excess of that required for the necessary chemical action.

3. The method of emplacing concrete in a road bed which comprises first laying and sperading a bottom layer of concrete of the desired depth and consistency and simultaneously applying rapid and violent vibrations thereto and then before such bottom layer has completely hardened and set applying thereto a second layer of concrete and condensing and compressing such second layer into a thinner layer while simultaneously applying rapid and violent vibrations thereto, the concrete mix of both layers containing only a small amount of water in excess of that required for the necessary chemical action.

WILLIAM P. DAY.