Aug. 2, 1938. G. H. HILL, JR. 2,125,785

METHOD OF RECONDITIONING ROADS AND PAVEMENTS

Filed Dec. 29, 1933 2 Sheets-Sheet 1

Fig. 1.

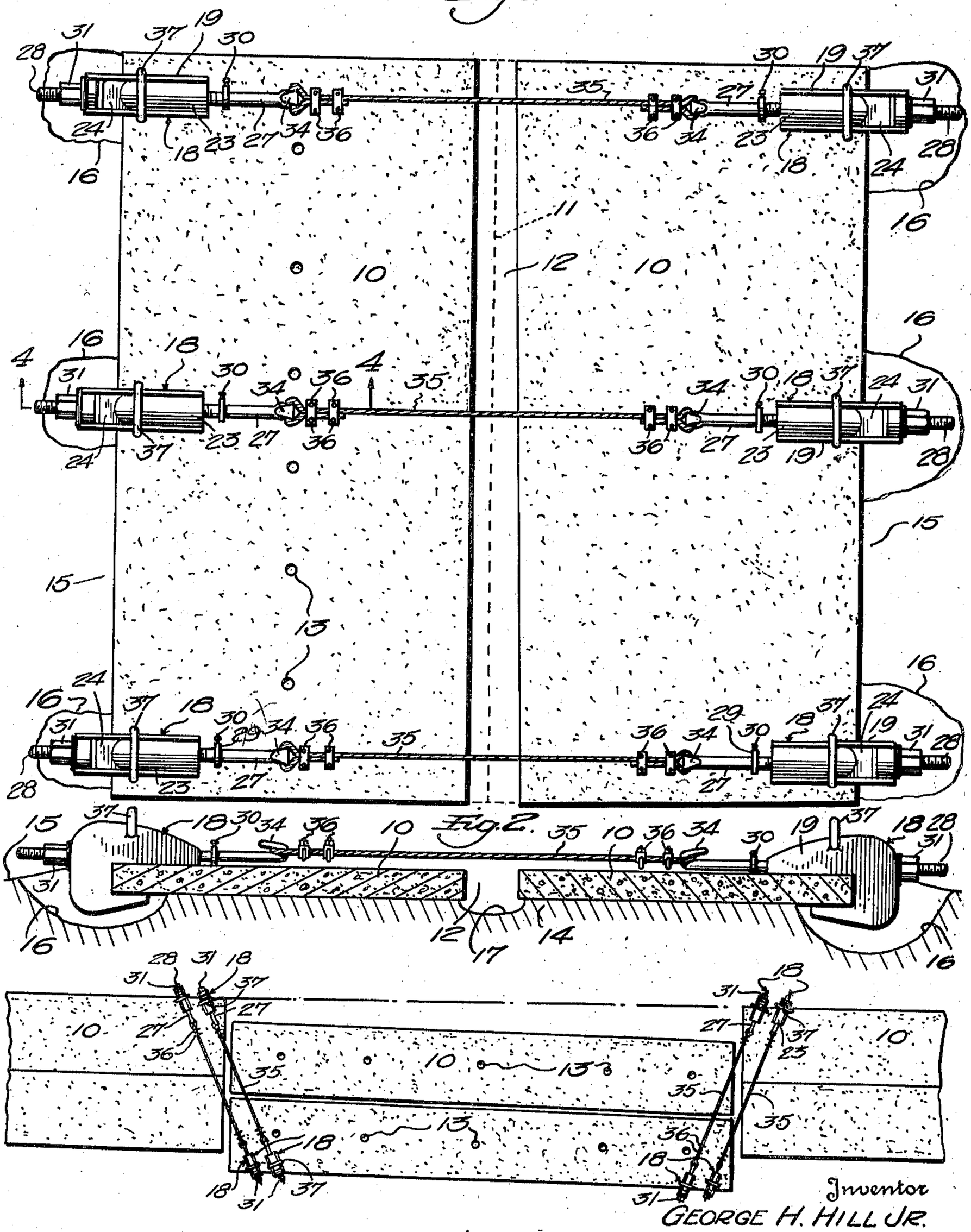

Fig. 2.

Fig. 3.

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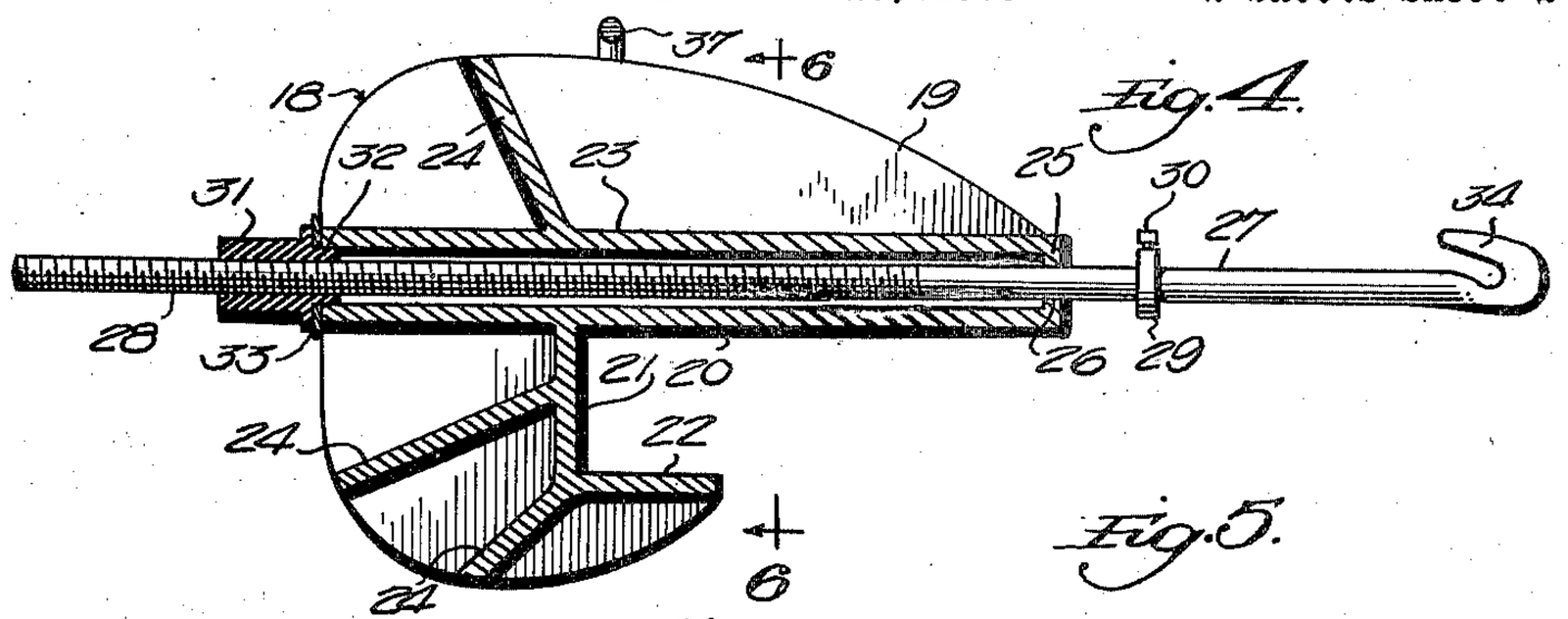


Fig. 4.

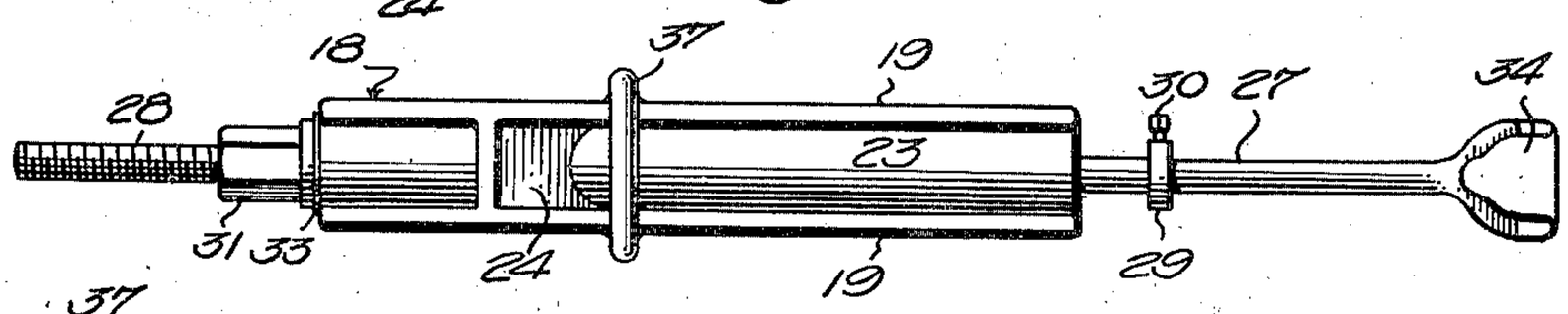


Fig. 5.

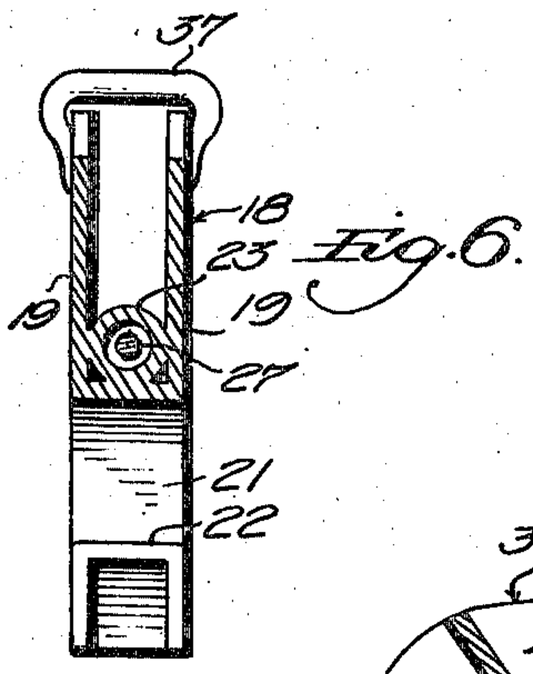


Fig. 6.

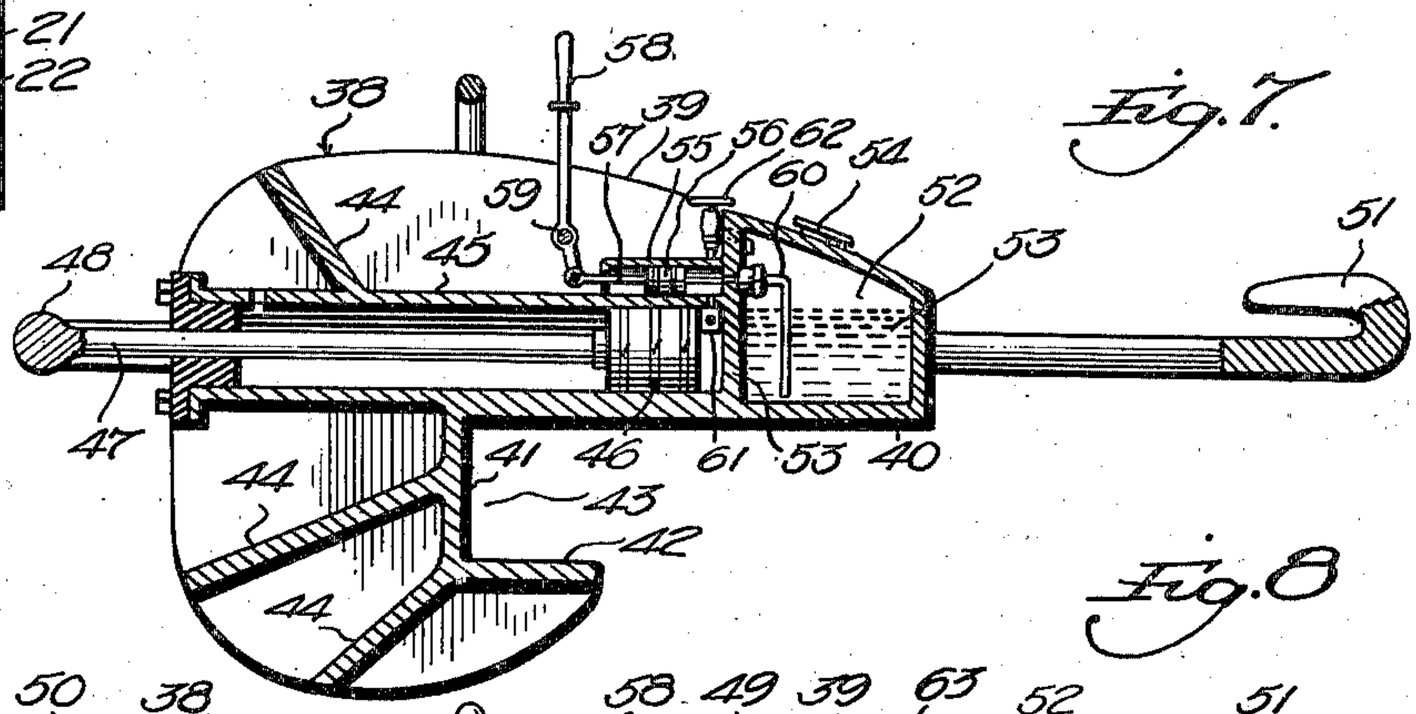
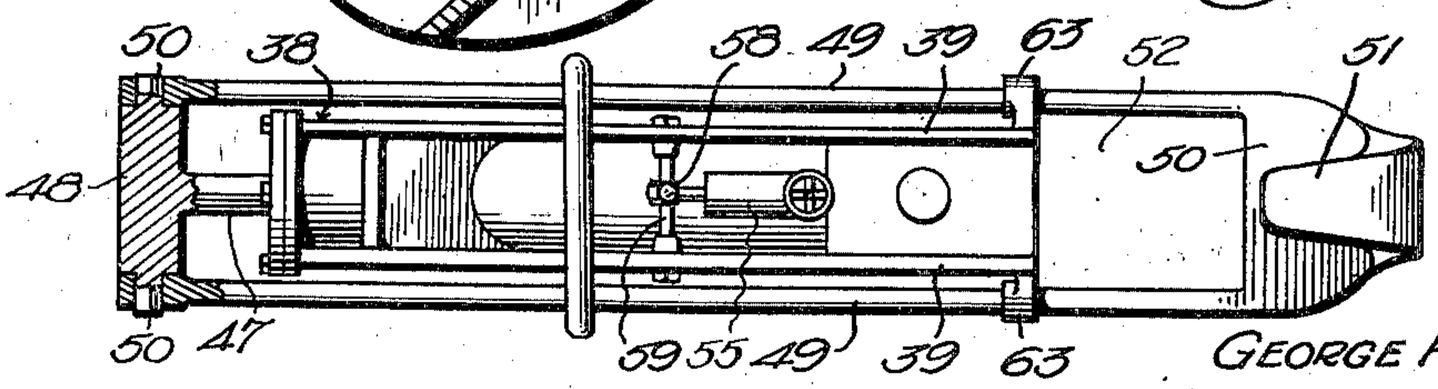


Fig. 7.

Fig. 8



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UNITED STATES PATENT OFFICE

2,125,785

METHOD OF RECONDITIONING ROADS AND PAVEMENTS

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Application December 29, 1933, Serial No. 704,588

12 Claims. (Cl. 94—22)

This invention relates to methods and apparatus for reconditioning roads and pavements and more particularly to a method and apparatus for moving displaced cement road slabs back to their original positions.

It is the common practice to construct concrete roads or pavements in two or more series of cement slabs varying from 7 to 14 feet in width cast side by side with their adjoining edges in contact with each other. The usual practice is to construct one slab, or a series of slabs, and, after the cement is sufficiently cured, to pour or construct the second slab or series of slabs against the first, using one edge of the first slab or series as a form against which one edge of the second series is constructed. In a like manner, a third series may be poured in contact with one edge of either of the first or second series, and such method is continued until the pavement or roadway is of the desired width.

After the construction of such a pavement or roadway, the subgrade or earth supporting one or more of the adjacent concrete slabs settles, thus resulting in the displacement of the slabs either vertically or horizontally, or both. Recently there have been developed several types of machines known variously as mud jacks, pavement jacks, etc., which are adapted to correct vertical subsidences of the slabs by injecting mud through holes drilled through the slab, and such operation may take place without interruption to traffic on the roadway. The action of such a jack is similar to that which takes place in a common hydraulic jack, the slabs being raised by hydraulic action to their original position, the slab itself acting as the piston of the hydraulic jack.

Until the development of the present invention, no method has been devised for correcting the horizontal displacement of the slabs. In cases where mud jacks and similar apparatus have been employed for raising a slab to its original position, there usually remains a substantial space between such slab and the adjacent slab at the side thereof. In some cases, the spaces between the adjacent parallel slabs has been sufficiently wide to admit the entrance of the tires of small motor vehicles, and thus such spaces constitute a distinct danger. Accordingly, after a slab has been elevated to its normal vertical position, it has been the common practice to fill the space between the slabs with some suitable material such as asphalt or tar, or the admixture of such materials with a mineral aggregate such as crushed limestone. The resulting repair removes the substantial danger present when an unfilled space is left to exist between two adjacent slabs, but the repair itself is nearly always rough and unsightly and is dangerous to traffic.

So far as I am aware, the only previously known method of correcting the condition referred to has been the removal of the displaced slab or slabs by the use of explosives or demolition tools and the replacement with a new slab or slabs constructed in the proper position. Obviously such a replacement of the slabs involves substantial expense. For example, the replacement of a slab 90 feet long and 10 feet wide will cost in the neighborhood of $3.00 per square yard or $300.00 for the replacement of the slab, plus the cost of the removal of the old slab, such cost being in the neighborhood of $30.00 and even more if the slab is reenforced.

An important object of the present invention is to provide a simple, practical and inexpensive method for moving displaced slabs of a concrete pavement or roadway horizontally to restore them to their original positions.

A further object is to provide a method of the character referred to wherein either or both of a pair of adjacent parallel slabs may be moved horizontally to bring their adjacent edges into contact with each other and to return them to their original positions with respect to the adjacent slabs.

A further object is to provide a similar method which is operative for simultaneously moving two adjacent parallel slabs in one direction, when such slabs have both become displaced in either direction from their normal positions, to restore them to such normal positions with respect to the adjacent slabs.

A further object is to provide a method of the character outlined which is operative for moving one or more pavement slabs horizontally to restore them to their normal positions without interrupting traffic moving on the pavement or highway.

A further object is to provide an apparatus which is particularly efficient in accomplishing lateral movement of the slabs without interfering with travel on the highway during the use of the apparatus.

A further object is to provide an apparatus by means of which the method outlined may be practiced without damage to the pavement by spalling or cracking the concrete slabs being moved.

A further object is to provide a simple form of apparatus for practicing the method referred to,

which is relatively simple to operate and requires no power for its operation other than the normal physical effort of one or two ordinary men.

A further object is to provide such an apparatus which is readily adaptable to any width of pavement or highway or to the combination of any number of adjacent parallel slabs.

A further object is to provide such an apparatus which may be easily handled by one man, both in manipulating the apparatus and in loading and unloading the component parts thereof for transportation to and from the site of the work.

A further object is to provide an apparatus for accomplishing the desired results which is relatively inexpensive to construct and operate and which is sufficiently rugged to withstand the great strain imposed upon it through constant use over a period of years.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings I have shown several forms of apparatus particularly adapted for practicing the method. In this showing,

Figure 1 is a plan view of a pair of laterally displaced highway slabs showing the apparatus in operation,

Figure 2 is a vertical transverse sectional view of the same,

Figure 3 is a plan view of a section of a highway illustrating the method of replacing two adjacent parallel slabs which have become laterally displaced in the same direction,

Figure 4 is a central vertical longitudinal sectional view through one of the clamps, taken substantially on line **4—4** of Figure 1,

Figure 5 is a plan view of one of the clamps,

Figure 6 is a section on line **6—6** of Figure 4,

Figure 7 is a view similar to Figure 4 showing a modified form of the invention, and,

Figure 8 is a plan view of the same, parts being broken away.

In my experiments I have discovered that a pavement or highway slab which has become laterally displaced from normal position may be moved laterally substantially more easily than a slab which has not been so displaced. This being true, I have discovered that a highway slab of substantial size, such as a slab 10 feet wide and 90 feet long may be moved laterally by applying edgewise pressure thereto without spalling, cracking or otherwise injuring the slab. It has been further found that since a displaced slab may be moved laterally more easily than one which has not been displaced, it is wholly possible to engage clamps around the remote edges of the slabs, connect the clamps to each other and then operate them, under which conditions, the displaced slab will be moved laterally toward its normal position without affecting the position of the slab which has not been so displaced. This is true even though it is obvious that identically the same edgewise pressure is applied to both of the slabs.

I have further discovered that the pumping of a liquid beneath the highway slab materially reduces the friction between the lower face of the slab and the subgrade or supporting earth, thus permitting the slab to be moved edgewise with greater ease than is possible under any other conditions. This fact has been utilized in the present method for moving laterally to normal positions two roadway slabs which have been displaced in opposite directions from their normal positions. For example, where a highway is constructed of two series of concrete slabs, it frequently happens that two adjacent parallel slabs will both be displaced laterally outwardly away from their normal positions. As previously stated, a displaced slab may be moved laterally more readily than one which has remained in normal position, and where the edgewise clamping action referred to is applied to two adjacent parallel slabs both of which have been displaced in opposite directions from normal position, it will be apparent that the slab with the lesser frictional engagement with the subgrade will move laterally more readily than the other slab.

As previously stated, it has been found that the pumping of a liquid beneath a highway slab reduces the frictional engagement of the slab with the subgrade, and this fact is utilized in replacing in the normal position two adjacent slabs which have both been displaced in opposite directions from their normal positions. In practicing the method with the replacement of slabs thus displaced, the clamping means is applied to the remote edges of the slabs and edgewise pressure is applied thereto in a manner to be referred to later. This edgewise pressure obviously moves only the slab which has the lesser frictional engagement with the subgrade, or moves such slab to a greater extent, and the edgewise pressure is applied to the slabs until the slab referred to is returned to its normal position. The application of the edgewise pressure is then discontinued and a liquid such as water is pumped beneath the other slab. This operation may be readily carried out by drilling suitable openings through the slab in question and pumping water or other liquid through such openings to reduce the surface friction between the slab and the subgrade. The resistance to the lateral movement of such slab thus becomes very much less than the resistance to the movement of the slab which already has been returned to normal position, and the application of the edgewise pressure may be then continued until the second slab has been returned to its proper position.

In practicing the method as outlined, it is obviously desirable that the parallel slabs be returned completely to their normal positions in edge to edge contact. To permit this complete operation to take place, proper steps should be taken prior to the actual movement of the slabs. Where one or both slabs of an adjacent parallel pair have moved laterally relatively away from each other, the space thus left between the two slabs is cleaned out, all earth, etc., being removed preferably to a depth of approximately one inch below the bottom surface of the slabs. The adjacent edges of the slabs also are preferably cleaned to remove all tar or filler therefrom and any rough spots or projections on the edges of the slabs are preferably knocked off. With this preliminary work properly done, the practice of the method permits the adjacent edges of the slabs to be brought into direct contacting relationship, which obviously is desirable.

The practice of the method also is applicable where two adjacent parallel slabs both have been laterally displaced from the same direction, although it will be apparent that the clamping action cannot be carried out in the manner previously described since both slabs must be moved laterally in the same direction to be replaced in normal position. To accomplish the desired result, therefore, the edgewise clamping pressure is applied at the outer edge of one of the displaced slabs at the side toward which it is dis-

placed, and at the opposite edge of one of the adjacent slabs which has not been displaced. The same application of the clamping pressure is applied at the opposite end of the displaced section, and the tightening of the clamping means thus effects lateral movement of both displaced slabs in the same direction so that they may be returned to their normal positions.

It obviously is substantially more difficult to move two adjacent parallel slabs both of which have been displaced in the same direction than to move the slabs singly, as in the case where only one slab has been displaced, or where the two adjacent slabs have been displaced in opposite directions. Accordingly it is preferred that two of the clamping means to be described be employed at each end of the displaced section to minimize the danger of spalling or cracking the slabs. It is further desirable that the friction between the displaced slabs and the subgrade be reduced in the manner previously described, namely, by pumping a liquid beneath the slabs. It sometimes occurs that both lateral and vertical movements occur in the same slab. In other words, it sometimes happens that a slab moves laterally away from its normal position and at the same time settles below its normal level with respect to the remaining slabs. In such cases, the slab should be first raised to its proper position by employing a mud jack or similar device to pump mud through openings drilled through the slab. The action of moving the slab laterally is then delayed until the mud thus pumped beneath the slab has had an opportunity to substantially firmly set, and this action requires a substantial length of time varying from six to forty-eight hours. The mud is pumped beneath the slab without destroying the berm in order to insure against the mud "blowing out" at the outer edge of the slab. The mud is permitted to "set" in order to prevent the occurrence of the same difficulty. In other words, if the slab is moved laterally, as soon as it has been elevated to proper position, the outer edge of the slab moves away from the berm and thus is apt to release the mud from beneath the outer edge portions of the slab. If the mud is permitted to set in the manner referred to, the possibility of this difficulty is overcome, and yet the slab may be readily moved laterally back to normal position.

One form of apparatus particularly adapted for practicing the invention is illustrated in Figures 1 to 6 inclusive. Referring to Figure 1 the numeral **10** designates a pair of parallel slabs forming a section of a pavement or highway, and both slabs have been illustrated as being laterally displaced from their normal positions. The dotted line **11** indicates the normal position of the adjacent edges of the slabs, and it will become apparent that the displacement of the slabs leaves a space **12** therebetween. One of the slabs has been illustrated as being provided with openings **13** drilled therethrough for the purpose of permitting the pumping of water or mud beneath the slab by means of a suitable apparatus such as a mud jack. The slabs rest upon a subgrade **14** (see Figure 2) and the berm **15** is cut away as at **16** at spaced points to accommodate the clamping devices to be described. In Figure 2, the space **12** between the adjacent edges of the slab **10** has been illustrated as being cleaned out below the bottom surface of the slabs as indicated by the numeral **17**.

One form of clamping device has been illustrated in detail in Figures 4, 5 and 6, and the application of the clamping devices has been illustrated in Figures 1, 2 and 3. Each clamping device as a whole has been designated by the numeral **18** in each of the figures referred to. Referring to Figures 4, 5 and 6, it will be noted that each clamping device comprises a pair of side plates **19** parallel to and spaced from each other, and the contour of the side plates will be apparent from Figure 4. The side plates are connected by cross plates **20**, **21** and **22**, and these plates define a notch to receive the edge of the slab as indicated in Figure 2. An elongated sleeve **23** extends from one end of the clamping device to the other. The side plates **12** are braced with respect to each other by the sleeve **23** and by suitable reinforcing webs **24**, as shown in Figure 4. The elements described make up the body of the clamping device and these elements may be made and assembled in any suitable manner. For example, these elements may be made of boiler plate suitably welded together, or the body of the clamp may be cast integral of a suitable grade of steel.

One end of the sleeve **23** is provided with a head **25** having a central opening **26** therethrough. A rod or bar **27** of substantial length extends through the sleeve **23** and is threaded throughout the greater portion of its length as at **28**. The threaded portion of the rod **27** is slidable in the opening **26**, as will become apparent. A collar **29** is slidably mounted on the rod **27** inwardly of the head **25**, for a purpose to be described, and may be secured against sliding movement on the rod by means of a set screw **30**.

A nut **31** is threaded on the rod **27** outwardly of the body of the clamp. This clamp is provided with an inwardly extending portion **32** engageable within the adjacent end of the sleeve **23**. The nut is engageable against a thrust washer **33** contacting with the adjacent end of the sleeve. At its opposite end the rod is flattened and turned upwardly and inwardly to form a hook **34**, and the end of a cable **35** is passed around the hook, the end of the cable being secured to the body thereof by clamps **36** or by any other suitable means.

The clamping devices are placed in position in pairs adjacent opposite edges of the highway, three pairs of the clamping devices being shown in Figure 1. The clamping devices are sufficiently light to permit them to be handled by a single workman, and if desired, each clamping device may be provided with a suitable handle **37**.

The form of the invention just described is adapted to be operated by turning the nuts **31** with suitable wrenches, and in Figures 7 and 8 a modified form of clamping device has been illustrated wherein fluid pressure is employed. Referring to Figures 7 and 8 the numeral **38** designates the clamping device as a whole. This device includes parallel side walls **39** shaped similar to the side walls **19** of the clamping device **18**. The walls **39** are connected by transverse walls **40**, **41** and **42** to form a pocket **43** adapted to receive the edge of a slab. The walls **39** are further connected to each other by suitable reinforcing webs **44**. A cylinder **45** is arranged between the side walls **39** and a piston **46** is adapted to reciprocate therein. A piston rod **47** is connected at one end to the piston and a crosshead **48** is connected to the piston rod at the other end. Parallel rods **49** are arranged on opposite sides of the clamping device and are connected to the crosshead **48** by means of trunnions

50 carried by the crosshead and extending through suitable openings in the rods 49. At their other end, the rods 49 are connected together as at 50, and the connected portion referred to is provided with a suitable hook 51 similar to the hook 34 previously described.

An oil reservoir 52 is formed in the clamping device as shown in Figure 7, and one wall 53 of the reservoir forms the adjacent end wall of the cylinder 45. The reservoir 52 is adapted to contain a body of oil or other liquid 53' poured thereinto through a suitable filling spout 54. Oil is adapted to be transferred from the reservoir to the cylinder 45 by a suitable manually operated pump. Referring to Figure 7 a pump cylinder is indicated by the numeral 55 and contains a piston 56 operable by a piston rod 57 pivotally connected thereto. An operating lever 58 is pivotally connected at its lower end to the piston rod 57 and is pivotally connected intermediate its ends as at 59 to the side walls 39.

Reciprocation of the lever 58 is adapted to pump oil under positive pressure into the cylinder 45. A small pipe 60 leads from the pump cylinder into the reservoir 52 to supply oil to the pump cylinder, and the latter communicates with the cylinder 45 through a suitable check valve 61. It will be apparent that a suitable check valve is arranged in the connection between the pipe 60 and the cylinder 55. Any suitable means may be provided for returning the oil to the reservoir 53 upon inward movement of the piston 56, and in Figures 7 and 8, a manually operable valve 62 is illustrated for this purpose. The pumping of oil into the cylinder 45 effects movement of the piston 46 away from the wall 53, and this movement is transmitted through the crosshead 48 and parallel rods 49 to the hook 51 to which one end of one of the cables 35 is connected. The walls 39 may be provided with guides 63 through which the rods 49 operate.

The operation of the form of the invention shown in Figures 4 to 6 inclusive will be first described in connection with the practice of the method in replacing two adjacent parallel slabs which have become laterally displaced in opposite directions as shown in Figure 1. The space 12 is first cleaned out and all dirt, stones, etc. removed to a point approximately one inch below the bottom of the slabs. All tar, filler, etc., is removed from the edges of the slab and any rough projections on the edges of the slab are preferably knocked off. Assuming that there has been no settling of the slabs, the berm will be dug away at spaced points adjacent opposite edges of the slab as indicated at 16 in Figures 1 and 2, the berm being dug away at opposite points to accommodate pairs of the clamping devices. A suitable number of the clamping devices are then engaged with the remote edges of the two slabs, the clamping devices being arranged in pairs as shown in Figure 1. The nuts 31 are backed off as far as possible toward the outer ends of the rods 27 and these rods are then pulled inwardly as far as possible. Cables 35 are then connected between the hooks 34 of the corresponding pairs of clamping devices, all the possible slack in the cables being taken up before they are clamped. The initial operation of moving the slabs then takes place and in this connection it will be noted that the cables 35 are flexible and relatively thin and lie close to the surfaces of the two slabs. Thus it will be apparent that there is no interruption to traffic since vehicles can pass at high speeds over the cables 35 without affecting the apparatus in any way. The parts of the apparatus have been somewhat exaggerated in Figures 1 and 2 with relation to the width of each slab, and in practice, there is ample space for one or more vehicles to pass over the cables, depending upon the width of the slabs 10 and the number of series of slabs employed in constructing the highway.

Wrenches are then applied to the nuts 31 to tighten them against the thrust members 33 and take up on the cables 35. It has been found that the method can be practiced to best advantage by first tightening the nuts of the clamps adjacent the center of the length of the slab and then tightening the nuts of the clamps progressively toward the ends of the slab. In Figure 1, three pairs of clamping devices have been illustrated, and accordingly the preferred method of replacing the slabs in normal position is to tighten the nuts of the center clamps, and then to tighten the nuts of the end pairs of clamps. The nuts of the center clamps are again tightened and the procedure is repeated until one or both of the slabs has been moved inwardly to the desired extent.

The relative movement of the slabs will depend upon the conditions present. As previously stated, I have discovered that when equal inward edgewise forces are applied to two adjacent slabs one of which is in normal position and the other of which has become displaced, the displaced slab will move inwardly while the slab in normal position will remain stationary. When the operation just described is practiced in connection with slabs of such character therefore, the displaced slab will be moved back to its normal position without the performance of any other operations. Dirt or other material then may be tamped in the space left by the inward movement of the slab which has been returned to normal position to restore the normal berm at the edge of the slab.

In Figure 1 of the drawings the apparatus has been illustrated in connection with two adjacent parallel slabs both of which have been displaced outwardly from normal position. In practically every instance, the application of the clamping force under such conditions will cause one slab to move at least to a greater extent than the other slab due to the difference in the frictional engagement between the slabs and the subgrade. Where both slabs have been displaced, therefore, the application of the clamping pressure is progressively carried out until one of the slabs has been returned to its normal position. The further application of the clamping force is then suspended until the slab which is still displaced is prepared for further movement.

In Figure 1, it may be assumed that the right hand slab will be moved to normal position ahead of the left hand slab, and when such position is reached, the further operation of the clamps will be suspended and a number of the openings 13 will be drilled through the left hand slab as indicated. By means of a mud jack or similar apparatus water or other liquid is then pumped beneath the left hand slab through the openings 13. I have found that an ordinary hand pump may be used for this purpose, and if a soft rubber hose is employed and inserted in the openings 13, the pressure of the liquid will expand the rubber hose into engagement with the walls of each opening thus substantially sealing the opening against leakage. A surprisingly low liquid pressure will suffice for pumping the liquid

beneath the slab, and in practice, it has been found that from 5 to 10 pounds pressure ordinarily is sufficient.

The pumping of the water beneath the left hand slab will definitely reduce the friction between this slab and the subgrade to a point substantially below the friction between the right hand slab and the subgrade. After the water has been pumped beneath the slab, therefore, the clamping action can be continued, and the right hand slab will remain stationary while the left hand slab will move laterally inwardly to normal position in edge to edge engagement with the right hand slab. The operation is then completed and the clamping devices may be removed, after which the holes **16** may be filled in and the berms at the edges of the road restored by tamping dirt or other material in the spaces left by the inward movement of the slabs.

It sometimes occurs that two adjacent parallel slabs will be laterally displaced together in one direction. For example, it is the present practice in the construction of concrete roads to bank the turns in the road to facilitate the movement of traffic, and at such points the subgrade of the road slopes toward the inside of the curve. At such point it sometimes occurs that the slabs will become displaced and due to the slope in the subgrade, both slabs of a parallel pair frequently move laterally toward the inside of the curve. The present method and apparatus contemplates the replacement of such slabs, and the method of utilizing the clamping apparatus for such purpose is illustrated in Figure 3.

Two sets of clamping devices are preferably arranged adjacent the ends of the misplaced section as indicated in Figure 3. In this way, the pressure is distributed between a greater number of clamping devices, thus minimizing the danger of spalling or cracking the slabs. Two clamping devices are arranged against the edge of the displaced section at the side toward which it is displaced and adjacent each end thereof, and the corresponding clamping devices are placed against the adjacent sections at the opposite edges thereof. The two slabs are preferably both drilled to permit water to be pumped therebeneath, as shown. It will be apparent that the edgewise pressure required for moving both slabs simultaneously is approximately twice the pressure required for moving a single slab, and the pumping of water beneath the slabs minimizes the pressure required for moving the slabs by reducing the friction of the slabs against the subgrade, thus requiring less effort in the replacing of the slabs. Moreover, it is advisable to reduce the friction in the manner described since this operation will substantially insure against the spalling or cracking of the slabs. As previously stated, a displaced slab may be moved more easily than one which has remained in normal position, but where both slabs are moved simultaneously at a point where the highway is substantially banked, the replacing of the slabs must be accomplished by moving them upgrade while the tendency is to pull the adjacent sections downgrade. The difference in the frictional engagement of the displaced sections and adjacent sections is thus reduced, and the pumping of the water beneath the slabs which are displaced insures the movement of such slabs without effecting any movement of the adjacent slabs. After the water has been pumped beneath the displaced section, the clamps are progressively tightened until the section is returned to normal position. The berm is then restored adjacent the edge of the replaced section as will be apparent.

From the foregoing it will be apparent that the method is applicable for replacing a single laterally displaced slab; for replacing two slabs which have been displaced in opposite directions; and for replacing two or more slabs which have both been displaced in the same direction. The cables **35** are flexible and lie close to the surface of the highway, and all of the operations described can be carried out without interruption to traffic since vehicles readily may pass over the cables **35** at high speeds. It further will be apparent that the application of the method permits the making of road repairs which have not previously been done, and the normal condition of the highway is replaced at low expense. After a section of the highway has been restored to normal condition, the nuts of the clamps are released and the cables removed, whereupon the parts of the apparatus may be moved to an adjacent section of the highway or loaded into a truck for transportation to a different point. The clamping devices are sufficiently light to permit them to be handled by one man, thus minimizing the labor costs involved in the apparatus.

When the form of the apparatus described is to be loaded on a truck for transportation, the collar **29** on each clamping device is preferably placed on the rod **27** at a point just beyond the threads thereon and the set screw **30** is tightened. The rod **27** is then moved to bring the collar **29** into engagement with the head **25** of the sleeve **23**, whereupon the nut **31** is turned up into engagement with the opposite end of the sleeve. This operation is performed solely for the purpose of preventing the rod **27** from sliding back and forth during the transportation of the device, thus protecting the threads **28** from undue injury. This is the only care which need be taken with the device and the clamping elements obviously are so rugged as to permit their continued use for a number of years without substantial injury. The rods **27** are relatively inexpensive and readily may be replaced when the threads **28** have become worn, but with reasonable care, these threads will last for long periods of time.

The method of using the form of the device shown in Figures 7 and 8 is identical with the method previously described, the only difference being that the modified form of the device operates by hydraulic pressure. When the clamping devices are placed in position, the valve **62** of each clamping device is opened, and the hooks **51** pulled inwardly to their limit of movement, whereupon the cable is connected between the hook **51** and the corresponding hook of the opposite clamping device. When the device is to be operated, the valve **62** is closed, whereupon the lever **58** may be operated to transfer oil or other liquid from the reservoir **52** into the inner end of the cylinder **45**. Suitable check valves are arranged in the connections **60** and **61**, as will be apparent, and the operation referred to forces the piston **46** outwardly under the pressure of the liquid. When the slab or slabs have been replaced, the valve **62** is opened whereupon the piston **46** will be moved manually inwardly, the opening of the valve **62** permitting the oil to return from the cylinder **45** into the reservoir **52**.

The number of clamping devices employed for replacing one slab which has been displaced or two slabs which have been laterally displaced in opposite directions depends largely on the length and width of the slabs. Ordinarily, it is preferred that the pairs of clamps be arranged not over 20 feet apart and that the pairs of clamps adjacent the ends of the slabs be arranged not less than 3 feet from the ends of the slabs in order to prevent the breaking of the corners of the slabs.

The description of the method involved specifically refers to the lateral movement of slabs, but the method is equally applicable for use where a slab or slabs have settled below their normal level. As previously stated, it is important that the slab be first elevated to its normal position before it is moved laterally and this is accomplished by pumping mud beneath the slab through suitable openings drilled therethrough. In order to prevent the blowing out of the mud at the edges of the slab, it is important that the mud be permitted to set and harden to a substantial extent before the slab is moved laterally. The time for the setting of the mud varies from 6 to 48 hours depending upon individual conditions, such as the amount of mud pumped beneath the slab to elevate it to proper position. After the mud has properly set the method is practiced in accordance with the foregoing description and the slab readily may be moved laterally back to its normal position.

The elevation of a slab prior to moving it laterally is accomplished in the manner stated, namely, by drilling openings through the slab and pumping mud therebeneath to elevate the slab. It will be noted however, that the elevation of the slab is not dependent upon the use of mud, since any other similar relatively thin plastic material may be used, such as a cement mixture. It is, of course, desired that mud be employed for the purpose stated in the interests of economy, but it will be understood that the present invention, as relating to the lateral replacement of a slab after it has been elevated to normal height, is not limited to the use of mud in raising the slab. It also will be apparent that the reduction of friction between a slab and the subgrade is not dependent upon the use of water, since any liquid may be employed.

It is to be understood that the forms of the invention and the method herein described are to be taken as preferred examples of the same and that various changes in the practice of the method and in the size, shape and arrangement of parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. The method of replacing in normal position one of a pair of adjacent slabs which has become relatively displaced laterally away from the other slab which comprises engaging an opposite connected pair of clamping means with the remote edges of the two slabs, and progressively tightening the clamping means until the displaced slab has been returned to normal position while resting on the supporting subgrade.

2. The method of replacing in normal position a highway slab which has become laterally displaced, which comprises arranging oppositely connected pairs of clamping means at spaced points across the highway with one clamping means of each pair engaging the edge of the displaced slab at the side thereof in the direction of its displacement and with the other clamping means of each pair anchored against movement adjacent the opposite edge of the highway, and progressively tightening the clamping means until the displaced slab has been returned to normal position while resting on the supporting subgrade.

3. The method of replacing a laterally displaced highway slab, which comprises pumping a liquid beneath the slab to reduce the surface friction between the slab and the subgrade, and applying edgewise pressure to the edge of the slab at the side thereof toward the direction of displacement of the slab to move the slab to its original position.

4. The method of replacing a laterally displaced highway paving slab, which comprises pumping a liquid beneath the slab to reduce the surface friction between the slab and the subgrade, and applying edgewise pressure to the slab at a plurality of spaced points along the edge of the slab at the side thereof toward the direction of displacement of the slab and along parallel lines substantially at right angles to such edge of the slab to move the slab to its original position.

5. The method of replacing in normal position one of a pair of adjacent highway paving slabs which has become relatively displaced laterally away from the other slab, which comprises pumping a liquid beneath such displaced slab to reduce the surface friction between such slab and the subgrade, engaging an opposite connected pair of clamping means with the remote edges of the two slabs, and progressively tightening the clamping means until the displaced slab has been returned to normal position.

6. The method of replacing a laterally displaced highway paving slab, which comprises drilling openings through the slab at spaced points, pumping a liquid through such openings to reduce the surface friction between the slab and the subgrade, and applying edgewise pressure to the edge of the slab at the side thereof toward the direction of displacement of the slab to move the slab to its original position.

7. The method of replacing in normal position one of a pair of adjacent highway paving slabs which has become relatively displaced laterally away from the other slab, which comprises drilling openings through such displaced slab at a plurality of spaced points, pumping a liquid through such openings to reduce the surface friction between such displaced slab and the subgrade, engaging opposite connected pairs of clamping means at spaced points along the remote edges of the two slabs, and progressively tightening the clamping means until the displaced slab has been returned to normal position.

8. The method of replacing in normal positions a pair of adjacent highway paving slabs which have become laterally displaced in opposite directions away from each other, which comprises engaging opposite connected pairs of clamping means at spaced points along the remote edges of the two slabs, progressively tightening the clamping means until one of said slabs has been returned to normal position, pumping a liquid beneath the other slab to reduce the surface friction betwen such slab and the subgrade, and then continuing the progressive tightening of the clamping means until such other slab has been returned to normal position.

9. The method of replacing in normal positions a pair of adjacent highway paving slabs which

have become laterally displaced in opposite directions away from each other, which comprises engaging opposite connected pairs of clamping means at spaced points along the remote edges of the two slabs, progressively tightening the clamping means until one of said slabs has been returned to normal position, drilling openings through the other slab at spaced points over the area thereof, pumping a liquid through such openings to reduce the surface friction between such other slab and the subgrade, and then continuing the tightening of the clamping means until such other slab has been returned to normal position.

10. The method of replacing a highway paving slab which has settled below its normal position and has become laterally displaced, which comprises drilling spaced openings through the slab, pumping a plastic material through the openings until the slab has been elevated to its normal height, permitting the slab to remain in such position until the plastic material has set, and then applying edgewise pressure to the edge of the slab at the side thereof toward the direction of lateral displacement of the slab to move the slab to its original position.

11. The method of replacing in normal position a pair of adjacent parallel highway paving slabs which have both become laterally displaced in one direction away from normal position, which comprises engaging pairs of connected clamping means between the longitudinal edge of one of the displaced slabs at the side thereof toward the direction of displacement and the opposite edges of the adjacent highway sections, and tightening the clamping means until the displaced slabs have been returned to normal position while resting on the supporting subgrade.

12. The method of replacing in normal position a pair of adjacent parallel highway paving slabs which have both become laterally displaced in one direction away from normal position, which comprises drilling spaced openings through both of the slabs, pumping a liquid through such openings to reduce the surface friction between the pair of slabs and the subgrade, engaging pairs of connected clamping means between the longitudinal edge of one of the displaced slabs at the side thereof toward the direction of displacement and the opposite edges of the adjacent highway sections, and tightening the clamping means until the displaced slabs have been returned to normal position.

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