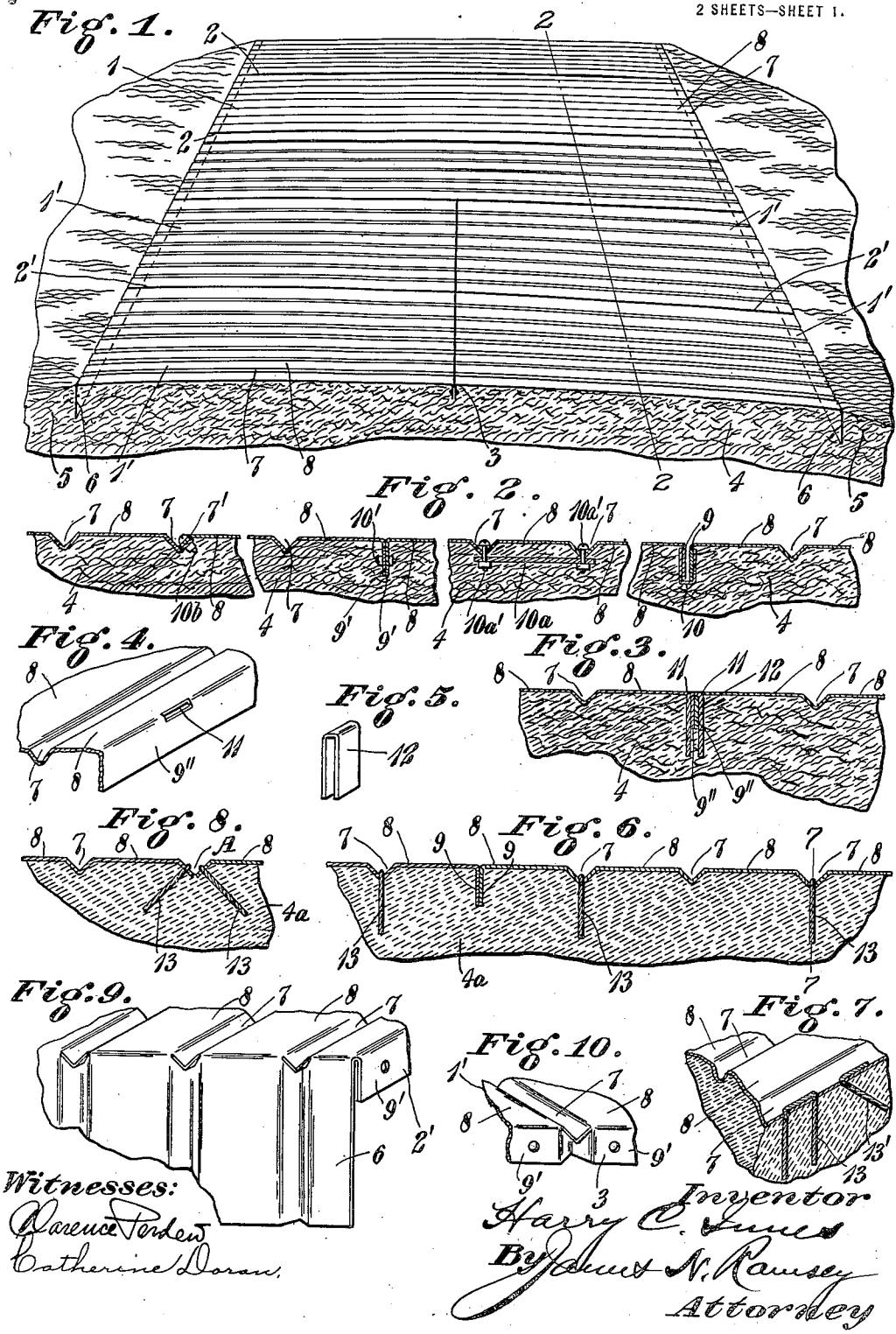


H. C. INNES.
ROAD, PAVING, FLOORING, OR LIKE STRUCTURES.
APPLICATION FILED NOV. 22, 1915.

1,277,936.

Patented Sept. 3, 1918.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 11.

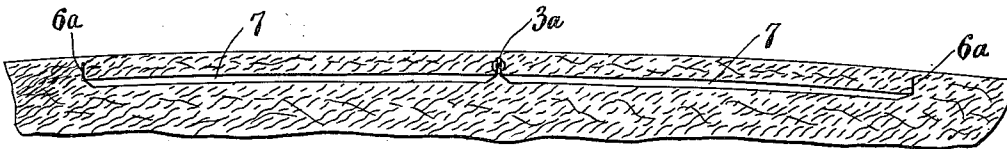


Fig. 12.

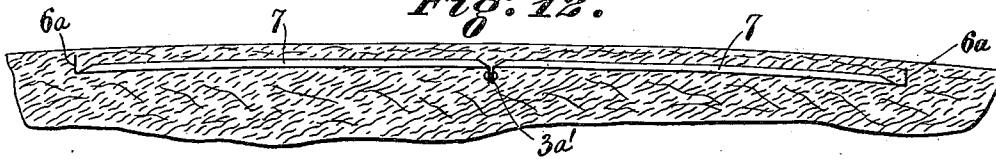


Fig. 13.



Fig. 14.

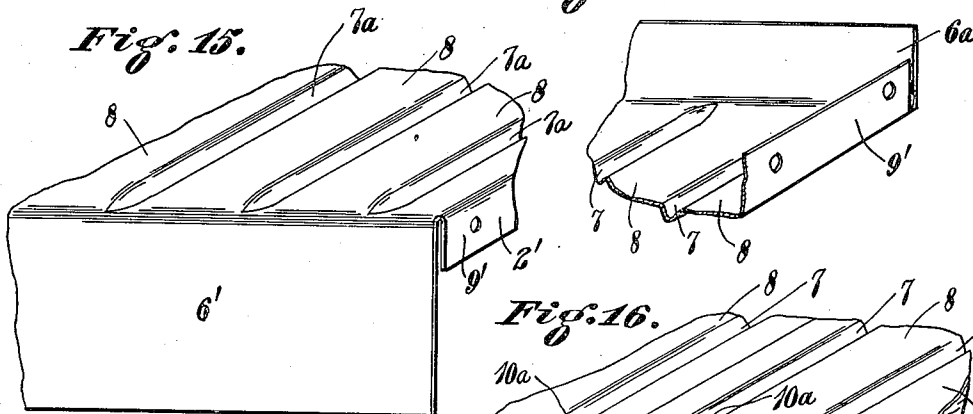


Fig. 15.

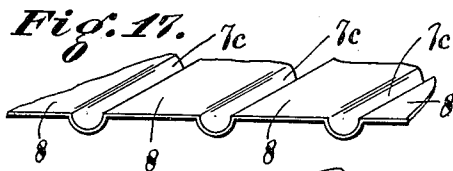


Fig. 16.

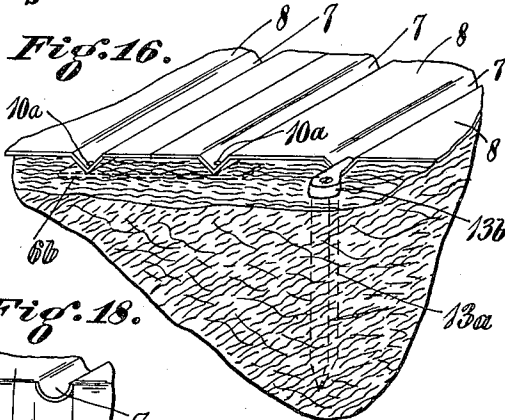
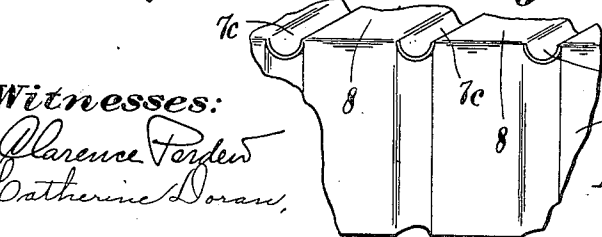


Fig. 17.



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UNITED STATES PATENT OFFICE.

HARRY C. INNES, OF CINCINNATI, OHIO,
ROAD, PAVING, FLOORING, OR LIKE STRUCTURES.

1,277,936.

Specification of Letters Patent.

Patented Sept. 3, 1918.

Application filed November 22, 1915. Serial No. 62,787.

To all whom it may concern:

Be it known that I, HARRY C. INNES, a citizen of the United States, and a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Road, Paving, Flooring, or like Structures, of which the following is a specification.

My invention relates to structures for roads, paving, or flooring for bridges, buildings or the like.

The object of my invention is to provide a road, paving, flooring or the like, favorable alike to rolling passage thereover and secure tractive hold thereon; and which will be durable; and which at the same time will be comparatively inexpensive to produce, transport and lay.

My invention consists in the combination of parts and in the details of construction and arrangement of parts as will herein be more fully described and claimed.

In the drawings:

Figure 1 is a sectional perspective view of part of a roadway provided with my improved surface structure shown as made up of a plurality of sectional units or elements to make up the width and length of the roadway, and also as made up of a single element across the width of the roadway;

Fig. 2 is a longitudinal vertical section on a line corresponding to the line 2—2 of Fig. 1, with parts broken away, and showing some different means for joining the structural elements;

Fig. 3 is a similar view showing another means for joining the elements;

Fig. 4 is a detail perspective view of part of one of the elements showing its flanged edge with a slot, and Fig. 5 is a similar view of a clip for extending through juxtaposed slots of two such elements as shown in Fig. 3;

Fig. 6 is a view similar to Fig. 2, but showing how my improved structure is used in conjunction with cement or concrete as a surface structure therefor;

Fig. 7 is a sectional perspective view of part of the structure, the section being taken on a line corresponding to the line 7—7 of Fig. 6;

Fig. 8 is a view similar to Fig. 6 showing another means of fastening the plates at their ends in a concrete structure;

Fig. 9 is a detail perspective view of part of one of the elements near its side and end showing the downwardly extending curb at the side and the flange at the end adapted for bolting or riveting the elements together;

Fig. 10 is a similar view of part of a side of an element, showing the side flange for bolting or riveting it to an adjoining element where a plurality of elements make up the extent of the surface structure across a roadway;

Figs. 11, 12 and 13 are vertical cross sections showing modifications of my invention;

Fig. 14 is a detail perspective view of part of one of the elements of Fig. 11 near its side and end, showing the upwardly extending curb at the side, and the flange at the end extending upward for bolting or riveting the elements together, the formation of the depressions at the edges being also modified from that shown in Figs. 1 to 10, inclusive;

Fig. 15 is a view similar to Fig. 9 showing a modification of the formation of the depressions in that they do not extend into the curb part of the element;

Fig. 16 is a detail perspective view of another modification in which there is no curb;

Fig. 17 is a similar view of a modification of the element in which the depressions have different cross section; and

Fig. 18 shows the element of Fig. 17 with a curb formed thereon after the manner shown in Fig. 9.

Tractive effort, considering it either as animal power exerted upon a vehicle with wheels or rollers, such as a man or horse drawing a truck or wagon: or as locomotive effort by a vehicle, such as the action of an automobile; involves two factors. The one may be called a tractive hold, or reaction, as for instance, the foothold of the man or horse or the hold which the tire of the automobile wheel has on a surface; and the other may be termed the resistance to traction, which is greater or less as the roughness or irregularity of the surface is greater or less.

It will be seen that the conditions more favorable to the first factor are less favorable to the second. Thus, a rough roadway

affords plenty of reaction for the tractive force whether this be the friction of a wheel tire or that of the foothold of a man or horse. But such a rough roadway will make more difficult the drawing of a vehicle there-
 5 over, especially a vehicle with wheels or rollers, each of which has a theoretical one-point bearing on a perfectly smooth surface, but which will have a decidedly two or more
 10 point bearing on a surface having rises and depressions over which the wheels or rollers must pass. On the other hand, a perfectly smooth roadway will offer ideal conditions for the passage of wheels or rollers, or even
 15 of a sliding conveyance such as a sled, but will allow the wheels or feet to slip so that practically no reaction to tractive effort is afforded.

In my invention I have recognized the necessity for compromising the conflicting
 20 claims of the above two factors of traction. That is to say I have provided about the proper proportion of roughness to provide the necessary reaction without objectionably
 25 raising the resistance.

The material susceptible of having both the greatest strength and greatest durability is iron or steel; preferably commercially
 30 pure iron, on account of its superior rust-resisting qualities. The expensiveness of the iron or steel is to be compensated for by using it only in such thickness as to enable
 35 it to wear long enough to be practicable and to have such strength as it needs in conjunction with practicable supporting means under it. Also, pure iron is most practically
 40 obtainable in the form of wrought sheets. Therefore the preferred material is sheet iron of as high as possible purity.

Thus the requirements for smoothness are met.

For affording the required reaction to tractive effort, the metal may have a coating
 45 which will be rough enough to materially increase the reactive resistance without materially lessening the smoothness. An example of such a coating is bituminous or asphaltic material with a sprinkling of gritty
 50 substance, such as sand, or fine gravel or broken stone.

A bituminous or similar moisture-resisting coating also acts as a preservative for the metal; and is advantageously applied
 55 also to the lower surface if the supporting material is not designed to have intimate junction with the metal. Such supporting material may be gravel, sand or earth tightly
 60 compacted; or may be the macadam of old roads; or may be wood or metal joists or supporting strips.

A filling and supporting material having intimate junction with the under surface of the metal would be cement or concrete.
 65 Making intimate junction with the metal will itself preclude any serious corrosion of

the under side of the metal surface structure.

The wearing surface of the metal may be advantageously but not objectionably rough-
 70 ened, according to the requirements above alluded to, by a coating such as above described. However, such coating on a sheet
 75 of metal left substantially plain throughout its wearing surface would be difficult to maintain; because the bituminous or similar material would be objectionably displaced,
 80 especially during high temperature, when the material would become softened; and because the sand or other gritty substance would become loosened under impact, not
 85 only leaving some parts of the surface too smooth, but acting as an abradent on the metal surface while thus being moved about under impact. Furthermore, a metal plate
 90 thin enough not to be too expensive will not have the requisite strength to resist bending and indentation with most of the filling and supporting materials above mentioned. A comparatively thin sheet may be used with
 95 carefully combined cement or concrete filling; but with the other fillings it is impracticable to provide such continuous and intimate contact of the filling and supporting material with the under surface of the sheet
 as to prevent all bending and indentation by the reinforcement of the filling and supporting material. Also, a plain sheet will be shifted out of position under the impacts of traffic.

Accordingly I prefer to provide the metal surface structure with depressions at intervals therein to increase the resistance to tractive effort above that afforded by such a means as a roughening coating. Also when a viscous ingredient is used in the roughening coating, as for instance bituminous material, the depressions form what may be called catch basins for the material if it has a tendency to flow, and act as reservoirs from which the material will be again distributed under the influence of traffic over the surface. Thus, while some displacement of the coating material will occur, it will not be through any considerable distance across the surface; and the coating material will be held in such condition that it will be re-distributed by the same action that causes its initial displacement. With such material, always adhesive to some extent, the inevitable dust and dirt of any roadway will also become incorporated with the surface coating; which, with the even support of the metal elements, will not materially resist the passage of vehicles, but will further add to the reaction to tractive effort, after the manner above described. These depressions will also serve as collecting places for this dust and dirt, from which the dust and dirt will be distributed over the surface. They also facilitate drainage, because the surface flow

will be confined to these depressions under most conditions, leaving the plane parts practically dry.

These depressions provide further reactive resistance for traction by having comparatively sharp or abrupt edges; and by having these edges presented as nearly as possible at right angles, in a horizontal plane, to the direction of all travel over the surface. Thus related to the direction of travel, however, the depressions will offer the most resistance to the rolling of wheels or rollers over the surface in the direction of travel. Here I compensate each of the factors by properly proportioning the widths of the depressions to the width of the undepressed or substantially plane surface between the depressions; so that while there are successive smooth areas, there is always a stopping of any slippage by a depression before the slippage has occurred to any objectionable extent. At the same time the depression is made narrow enough so that a wheel or roller will not drop down into it to an objectionable extent, and the width of the undepressed part will be so much greater than that of the depression that a greater proportion of the total surface is practically smooth and favorable to the rolling passage.

All of the above advantages are involved whether the metal be comparatively thin or not. Where the metal is in the form of a thin sheet, these depressions will be formed in the sheet as corrugations, and will add to the strength of the surface structure to such an extent that it will be sufficiently self-supporting to not be bent or indented where the filling and supporting material fails to provide continuous support. Also, the depressions will, on the under surface, engage with the supporting material and prevent slippage or creeping.

In accordance with the above requirements a surface for roads may be made as shown in Fig. 1. The surface structure may be made up of a plurality of elements 1, each long enough to extend entirely across the roadway and succeeding longitudinally of the roadway with transverse joints 2 between adjacent elements. Or, where it is desired to make the elements shorter, or if the roadway is very wide, a plurality of elements, such as the two elements 1', may make up the extent of the surface structure across the roadway and have joints longitudinally of the roadway, such as the joint 3. Such a plurality of elements 1' may have joints 2' transversely of the roadway similar to the joints 2 of the continuous elements. Such a structure is laid upon a bed of supporting material 4 which has been prepared by closely compacting it, as by rolling, and preferably by giving it a slight crowning as indicated. The smoothness of the surface

structure, however, enables it to shed water with comparatively little crowning. This compacted bed 4 may be flanked by earth berms or shoulders 5, which may slant downwardly and outwardly to ditches or other suitable drainage means.

To fix the surface structure on its bed 4, I provide as shown in Figs. 1 and 9, along its opposite longitudinal edges, downwardly extended flanges or curbs 6 which are forced down into the bed 4; it being understood that when the surface structural elements are suitably joined together and laid they are forced closely down against the bed 4 by suitable heavy pressure, as by means of a road roller or by tamping. With these curbs 6 thus provided, the surface structure is not only held against sidewise shifting; but the upper filling material of the bed 4, which is likely to be disturbed and shifted under the impact of travel, will be held in place by these curbs 6 against lateral displacement. Where a single element 1 extends entirely across the roadway, it will of course be formed with such a curb 6 at each end; and where a plurality of elements 1' make up the transverse extent, only those along the sides of the roadway will have curbs 6, and these are at one end only of each of the elements, while the opposite edges of these elements are provided with suitable means for forming the joints 3; and all of the elements would have means on their opposite edges for forming the joints 2 or 2', as the case may be.

The depressions or depressed parts 7, alternating with the undepressed or substantially plane parts 8, may be of substantially V-shaped cross section, or, as the depressed parts 7^c in Figs. 17 and 18, of semi-circular cross-section, and each preferably of a depth somewhat less than its width. These depressions 7 are of such width and occur at such intervals that they are not over half the width of the intervening undepressed parts 8. As here shown they are about one-third the width of the plane parts, preferably the width of the depression being about one inch, and that of the plane part three inches. The plates may be from one-eighth to one-fourth inch thick, depending upon the character of the traffic over the roadway. The bottom of the depression 7 may have an ample fillet, but the upper edges of the depression, where the undepressed part joins the depressed part, should be as abrupt as it is practicable to make them without breaking or weakening the material in bending, to afford a good tractive hold. In all cases, the depressed parts are preferably continuous between the plane parts, keeping the bed material under, and the surface coating on top of, the sheets.

In Fig. 2, several styles of transverse joints are illustrated. Thus the plates may

have bent-down flanges 9 to come adjacent to each other and be flanked by the sides of channels 10 running throughout parts or all of the length of the joint, and fitting in the channel. Such a joint will allow some contraction and expansion, and is desirable as a transverse joint like the joints 2 and 2'. Where it is not required to allow for contraction and expansion, flanges 9' may have openings through which may pass bolts 10'. A more permanent fastening may be made by means of cold-riveting. Expansion joints are seldom necessary, because the transverse corrugation of the material affords considerable compensation for contraction and expansion under varying temperatures.

The plates may be without flanges at their edges, and straps 10^a may lap under adjacent corrugations with bolts 10^a passing through the bottoms of the corrugations and through the straps 10^a. Also the plates may be formed each with half of a corrugation 7' on one edge and a complete corrugation 7 on the other, and the half corrugation of each plate brought into the corrugation of the adjacent one and bolts 10^b passed through the overlapping parts of the corrugations. In either case, the head of the bolt, being confined in the corrugation or depression, is out of the way of traffic.

Instead of the channel 10 as shown in Fig. 2, the plates may have slots 11 where their flanges 9'' are bent down. The plates are brought together with the slots 11 juxtaposed, and clips 12 have their legs passed down through the respective slots 11 in the two plates, as shown in Fig. 3. This is a fastening means that is readily completed without necessity of access to the bottom of the structure, and is therefore more convenient than those previously described. The legs of the clips 12 may extend down into the ground or supporting material far enough to afford considerable resistance to lateral displacement of the plates.

It will be understood that plates may be formed with corrugations and with flanges and curbs as above described at the mill, and then shipped to the road-building site, after which they are fastened together in a suitable manner such as by some of the means above described, and then laid upon the previously prepared filling and supporting material of the roadway. If it is an old road that is to receive the surface structure, it may require very little preparation. Also, where the traffic is not heavy, new roads may be constructed of the local soil properly banked and compacted to receive the surface structure as above described. Where the soil consists principally of sand, it may be shaped and wetted, the metal structure laid, and then the whole rolled to bring it into the proper compact condition.

The curbs 6 and flanges 9', or any other flanges described, may be formed on the edges of the corrugated plates at right angles to the corrugations preferably as shown in Figs. 9 and 10, by suitably slotting the plates in their corrugations along the line of the bend, so that the bent-down curb or flange has a crotch at the upper end of each corrugation receiving the bottom of the part of the corrugation remaining horizontal in the main part of the sheet, as in Figs. 9 and 18.

Another way, to provide the plates with curbs and flanges is as shown in Figs. 14 and 15, in which the corrugations or depressions 7^a gradually diminish in depth as they approach the place of bending of the curb or flange, and terminate at or near this place of bending. Where this modification is adopted, the curb 6' may be without corrugations, as is indicated in Fig. 15.

Where the surface structure is a supporting bed of cement or concrete, such as the bed 4^a in Fig. 6, the flanges 9 may form the transverse and longitudinal joints by being simply brought together and embedded in the cement or concrete. Also the surface structure may be very firmly secured to its bed by the passage of inverted U-shaped or otherwise suitably formed clips 13 or 13', as best shown in Fig. 7. In intermediate parts of the plates, these clips 13 have their legs passed down through openings in the bottoms of corrugations at suitable intervals. Another form of transverse joint may be provided in connection with cement or concrete as shown at A in Fig. 8, where each adjoining plate has, as its edge part, the inner outwardly and downwardly inclined side of one of the corrugations 7. These sides have their edges approach to each other where they are embedded in the concrete, and clips 13 are passed through openings in these edge parts divergently under the respective plates into the concrete. This arrangement affords some compensation at the joint for contraction and expansion.

It will of course be understood that, when installing this surface material in connection with cement or concrete, the elements are placed on the cement or concrete bed and embedded therein, and all of the fastening means are inserted, while the bed is in a green condition. The fasteners 13 or 13' are preferably made of twisted bars, or otherwise formed to have effective holding in the concrete or cement when it sets.

When the surfacing material is applied while the bed material is yet in a green condition, and with definite fastening means extending from the surface material into the bed, an intimate junction of surfacing material and the friable concrete bed is formed, greatly adding to the durability of the complete structure.

In the modifications shown in Figs. 11, 12 and 13, the structure has its curbs 6^a extended upward instead of downward, so that they provide lateral support for the filling material on the surface of the metal structure instead of for the supporting material under such structure as in the preceding examples. When the plates are provided in this way, the disintegrated or friable surfacing material of earth, gravel, or any other usual road surfacing material may be considerably thicker than in the preceding examples. It will be understood that the corrugations 7 running transversely will still perform virtually the same function, although not by direct coaction with the wheels of the vehicles, or feet of the animals or persons passing over the surface. However, these corrugations will coact with the disintegrated or friable surfacing material, preventing it from shifting longitudinally under the impacts of traffic, and by thus supporting and maintaining this surfacing material against shifting and in an even condition, the advantages of such material for providing tractive hold and at the same time ready rolling of wheels thereover is afforded without the detrimental effects of such material when not adequately supported, as in ordinary roadways or paving structures.

In Fig. 11 the corrugations 7 have the same relative positions as in the preceding examples, but where the width of the roadway is made up of a plurality of lengths of plates, the joining flanges 3^a are extended upward like the curbs 6^a.

In Fig. 12, although the curbs 6^a are extended upward, the corrugations 7 are presented downwardly as are also the flanges 3'. That is to say, the elements are formed with the flanges 3^a in a relative position different from that in the preceding examples, and the elements are inverted when installed.

As a matter of practice, the curbs 6^a are not as deep as are the curbs 6 of the preceding examples. The permissible depth of the surface material in these modifications is about 2½ inches.

In Fig. 13, corrugations 7^b run longitudinally of the roadway instead of transversely, for preventing lateral slippage of the structure; thus serving somewhat the same purpose that the downwardly extended curbs would; while at the same time the structure has the upwardly extended curbs 6^a at the sides to confine the filling material. However, such longitudinal corrugations 7^b will not afford the desired resistance to longitudinal slippage of the surfacing material.

A very simple installation of my invention may be effected as shown in Figs. 16 and 17, when the elements are not provided with lateral flanges or curbs. When thus made, they may be fastened to longitudinal iron

or steel bars 6^b by means of bolts or rivets 10^a passing through the bottoms of the corrugations. These bars may extend the entire length of the road, or be only at joints, as shown. Where these are used, stakes 13^a may be driven into the bed of the roadway, with the elements properly attached to them, as by metal caps 13^b engaging over the upper sides of the plates in the corrugations. Such a construction is suitable only for the lightest traffic.

Also Fig. 17 shows a modification of the shape of the corrugations or depressions. Thus, the corrugations or depressions 7^a are of substantially semi-circular cross section. Such cross section affords a junction at the upper edges of the surface more nearly at right angles, affording a better tractive hold, and is in this respect superior to the V-shaped formation shown in the preceding figures. It is also more favorable to the passage of the fastening means through the bottoms of the grooves or depressions. It will be understood that this and other forms of corrugations running uninterruptedly either across or along the sheet may be used in any of the preceding examples or in any of those hereinafter to be described.

The above description alludes more particularly to the construction of country roads; but it will be understood that the same principles of construction apply to paving of city streets or alleys or other areas where the traffic is heavier and more continuous; and also to paving in connection with tracks, such as electric railway tracks and steam railway tracks, passing along or across streets or roadways. When the track passes along the street as does the electric street railway track and as do occasional steam railways in cities, the surface structure will have its depressions or corrugations extending at right angles to the rails of the track; because the direction of street or road traffic, except at intersections, is the same as that of the railroad traffic. Only at railroad crossings will the corrugations run in the same general direction as do the rails of the track.

It will also be understood that my improved surface structure is suitable for floors where heavy trucking and other operations are performed, as in mills, factories, blacksmith, boiler and machine shops and the like, where it will be required to be laid either independently of or in conjunction with tracks as above described. In such cases, the weight of the metal may be materially increased, or if not, the combination with the metal of the concrete or cement bed will be especially of advantage. Naturally these more expensive constructions may be more advantageously used for interior work, where the extent of the structure is not so great; but where the impacts thereon may be fre-

quently far greater than those ever sustained on roads or street pavements.

From the foregoing it will be understood that my invention is susceptible of considerable modification to adapt it to various requirements met with in practice. Therefore, I do not wish to be understood as being limited precisely to the example herein illustrated and described, but what I claim as new and desire to secure by Letters Patent is:

1. A structure for roads, paving, flooring or the like comprising sheet metal elements formed with curbs along opposite edges of said structure substantially parallel with the direction of travel along the structure, disintegrated bed material flanked and held in place adjacent to said elements by said curbs, each of said elements being of substantially uniform thickness throughout and formed with a series of undepressed parts, and depressed parts alternating between the undepressed parts, and continuous with said undepressed parts which they are between, and having their dimensions in the direction of travel along said elements so proportioned relative to the undepressed parts of said elements that there is sufficient tractive hold without objectionable obstruction to rolling passage along the upper surface of said elements, and whereby the lower surfaces of said continuous depressed parts are embedded in said bed material, and adapted to prevent slippage of said parts on said bed material, or sifting of said bed material through said element, and means attaching adjacent ones of said elements together.

2. A structure for roads, paving, flooring or the like, comprising sheet metal elements, friable bed material held in place adjacent to said elements, each of said elements being of substantially uniform thickness throughout and formed with a series of undepressed parts, and depressed parts alternating between the undepressed parts, and continuous with said undepressed parts which they are between, and having their dimensions in the direction of travel along said elements so proportioned relative to the undepressed parts that there is sufficient tractive hold

without objectionable obstruction to rolling passage along the upper surface of said elements, and whereby the lower surface of said continuous depressed parts are embedded in said bed material and adapted to prevent slippage of said element on said bed material, or sifting of said bed material through said element, and means attaching adjacent ones of said elements together.

3. A structure for roads, paving, flooring or the like, comprising sheet metal elements formed with curbs along opposite edges of said structure substantially parallel with the direction of travel along the structure, filling material flanked and held in place adjacent to said elements by said curbs, each of said elements being of substantially uniform thickness throughout and formed with a series of alternating plane parts, and depressed parts continuous between the plane parts, running uninterruptedly at a substantial angle to the direction of travel along said elements, and having their dimensions in said direction so proportioned relative to said plane parts that there is sufficient tractive hold without objectionable obstruction to rolling passage along the upper surface of said elements, and whereby the lower surfaces of said depressed parts are embedded in said bed material and adapted to prevent slippage of said element on said bed material, and means attaching adjacent ones of said elements together.

4. A structure for roads, paving, flooring or the like, consisting of a bed, a surface element composed of sheet metal of substantially uniform thickness throughout, formed with a series of alternating plane parts and depressed parts continuous between the plane parts, running uninterruptedly substantially transversely of the direction of travel along said structure, and separate fastening means engaging said element within some of its depressed parts and extending into said bed to hold said elements in place.

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