8 Sheets. Sheet 1.

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Railway Track.

No. 1,558. Patented Apr. 18, 1840.

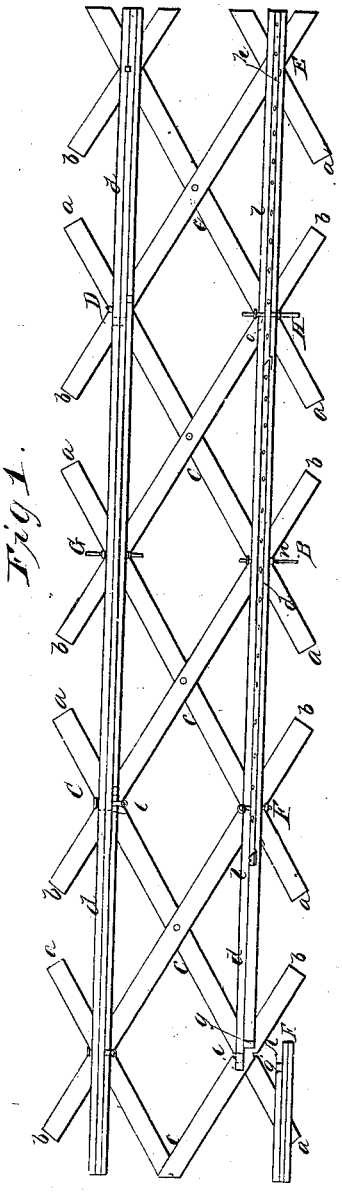

Fig 1.

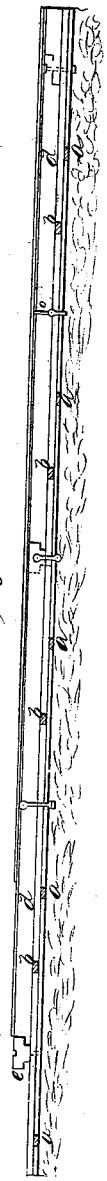

Fig 2.

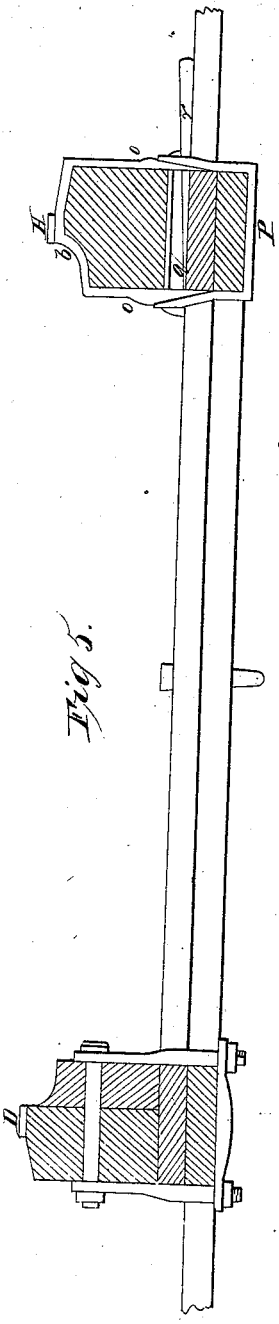

Fig 3.

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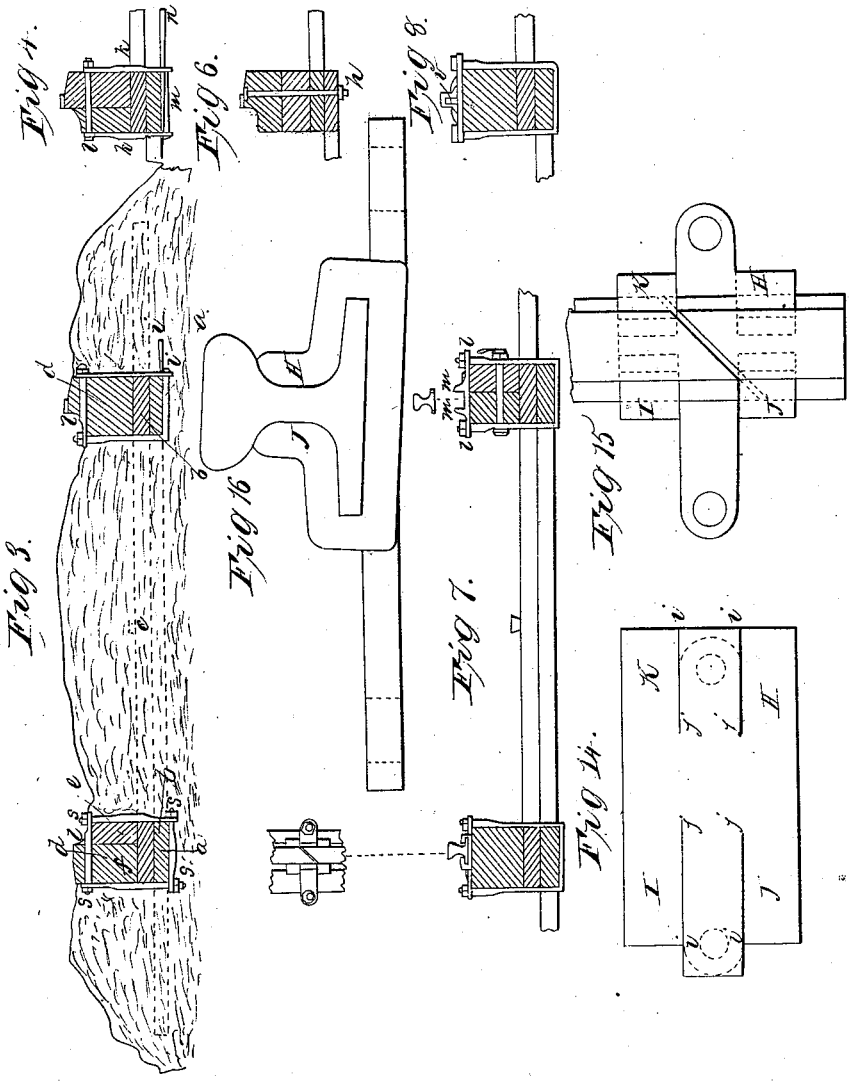

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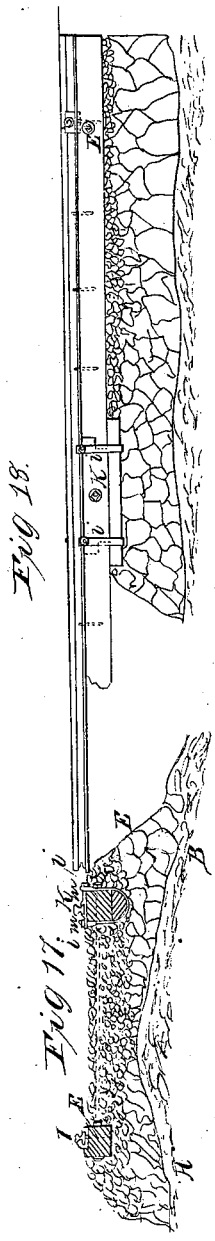

Fig 18.

Fig 17.

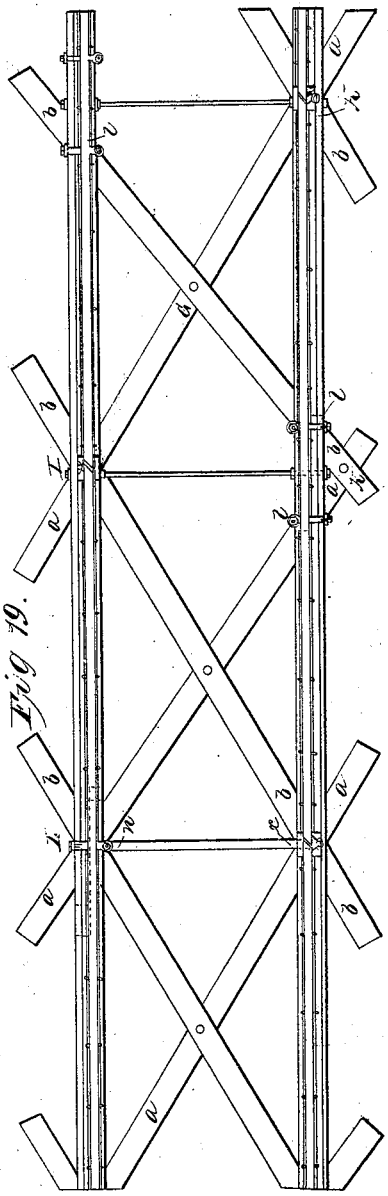

Fig 19.

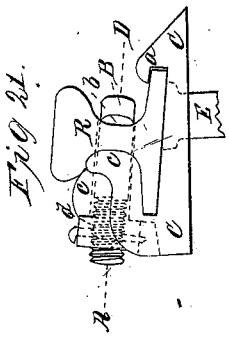

Fig 21.

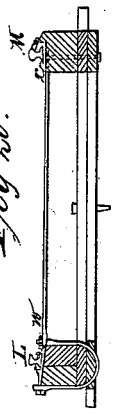

Fig 20.

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Fig 24.

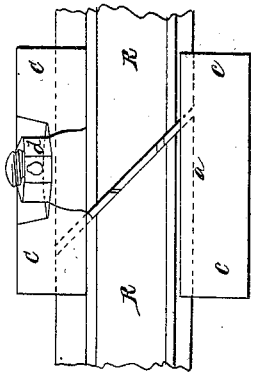


Fig 26.

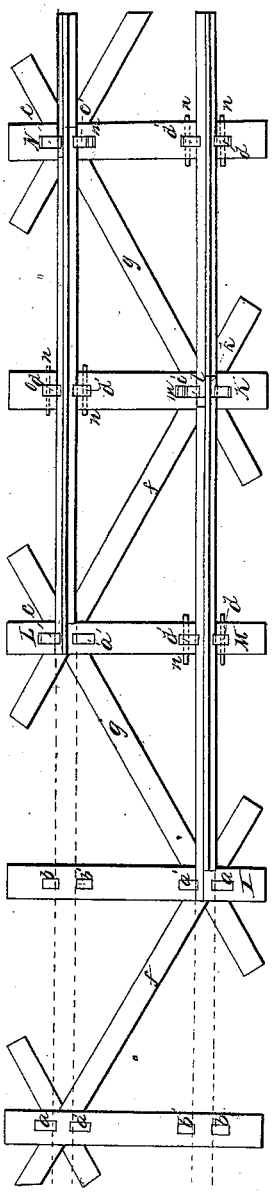


Fig 27.

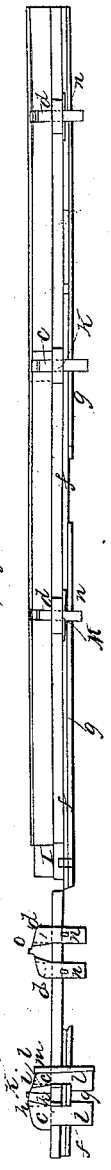
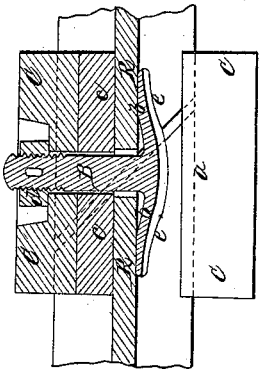


Fig 25.



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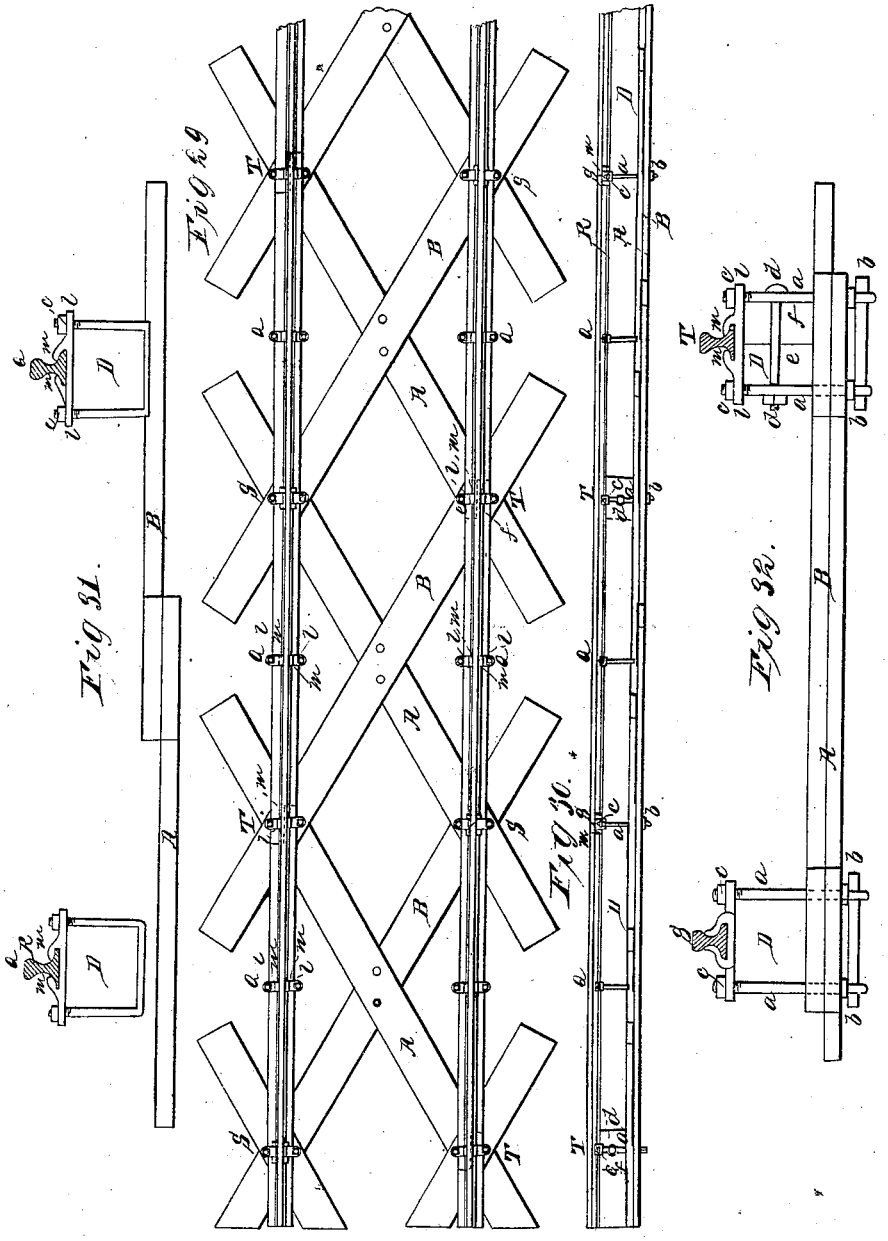

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Fig 33.

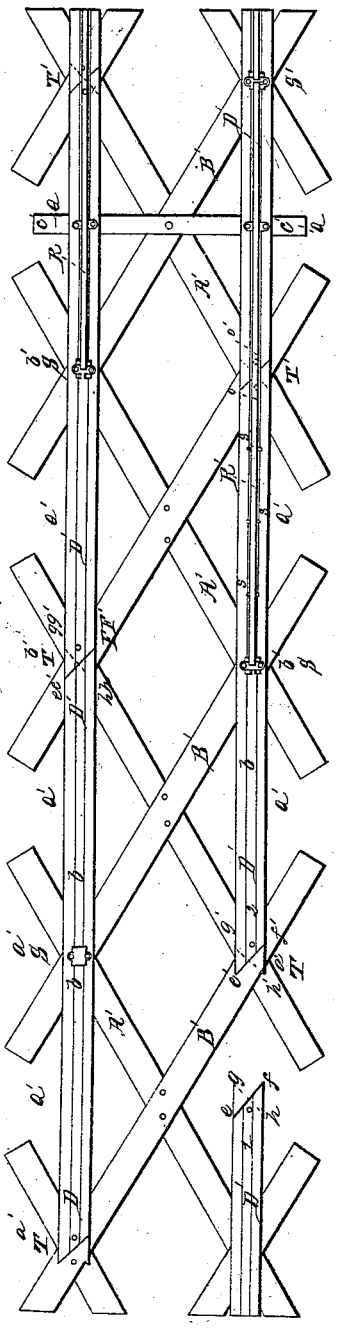


Fig 34.

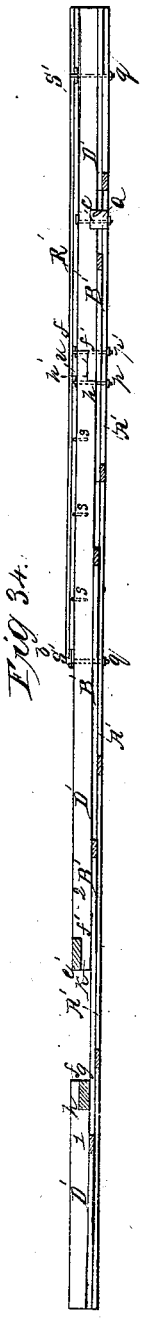


Fig 37.

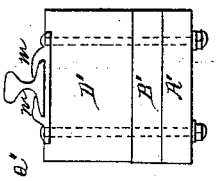


Fig 36.

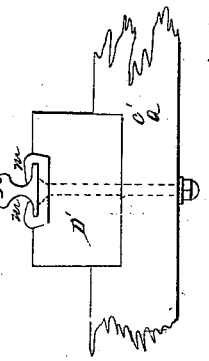
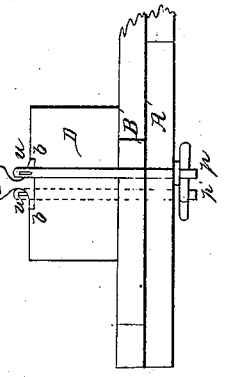


Fig 35.



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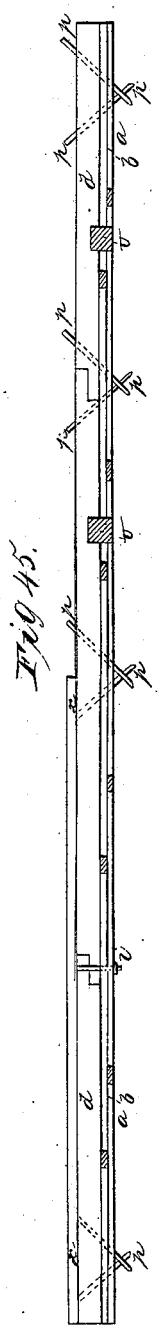

Fig 45.

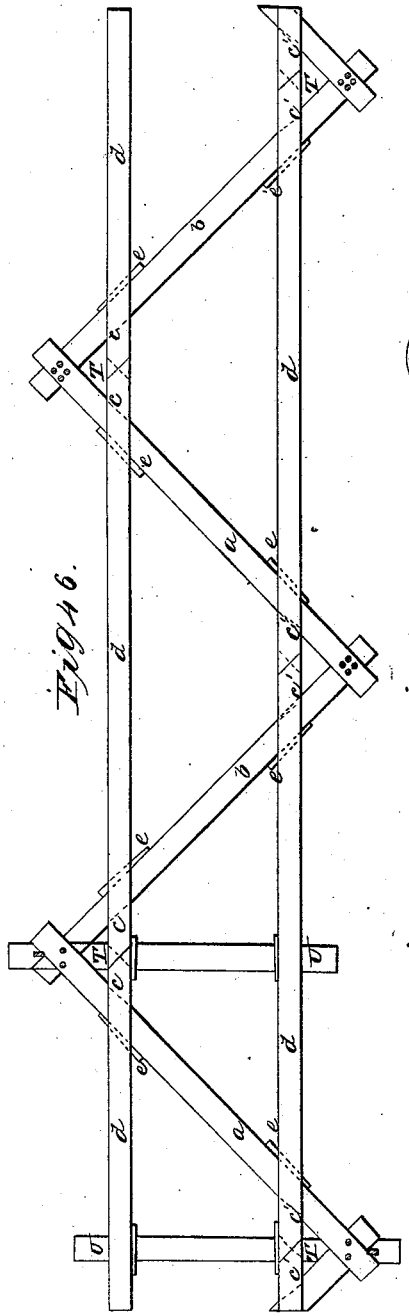

Fig 46.

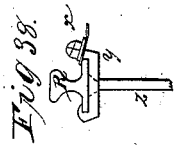

Fig 38.

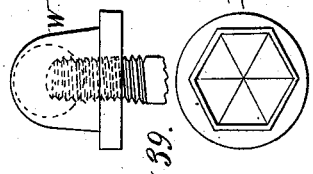

Fig 39.

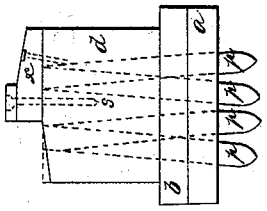

Fig 42.

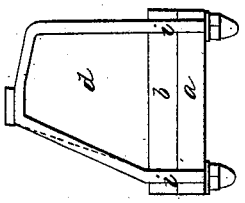

Fig 41.

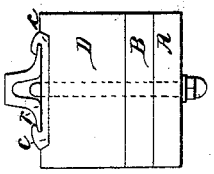

Fig 40.

8 Sheets. Sheet 8.

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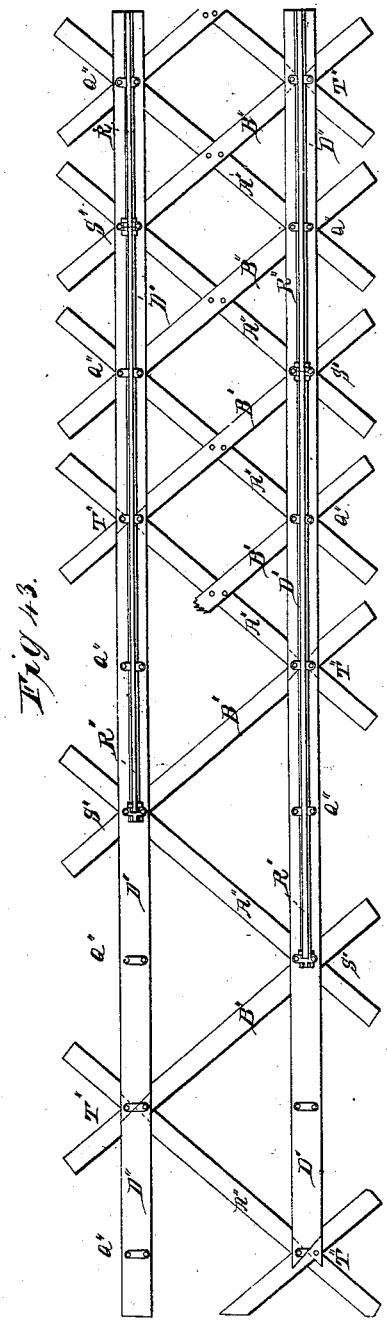

Fig 43.

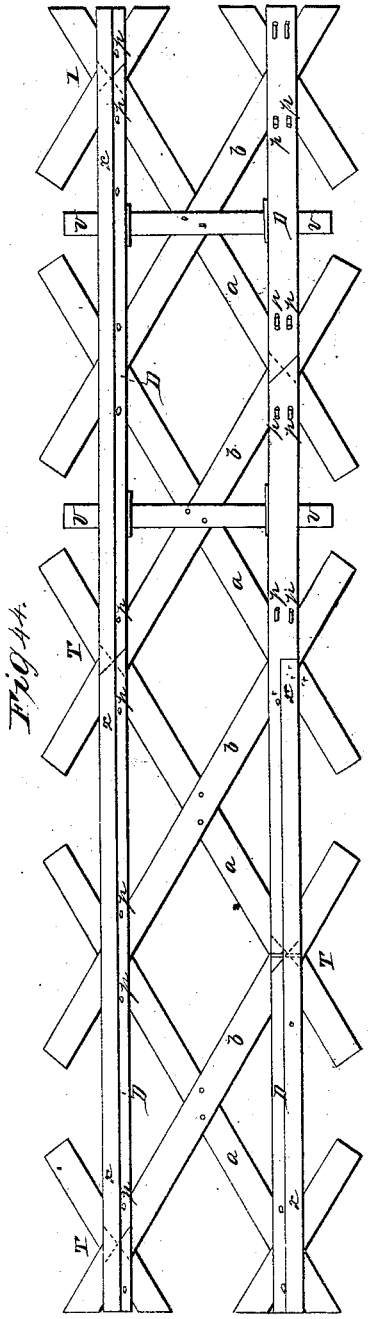

Fig 44.

UNITED STATES PATENT OFFICE.

JAMES HERRON, OF BALTIMORE, MARYLAND.

CONSTRUCTION OF RAILROADS.

Specification of Letters Patent No. 1,558, dated April 18, 1840.

To all whom it may concern:

Be it known that I, JAMES HERRON, civil engineer, late of Raleigh, North Carolina, and at present a resident of Baltimore, Maryland, have invented a new and Improved Construction of Railroads; and I do hereby declare that the following is a full and exact description.

The mode in which rail roads have hitherto been constructed is described in the third London edition of Wood's treatise on rail roads, also, in the printed reports of the Baltimore and Ohio Rail Road Company, and in many other publications on the subject anterior to the promulgation of my improvements. That is string-pieces of wood, or rails of iron, are supported either on blocks of stone, or on cross-sills of timber; or having a continuous bearing on the road bed, are at longer intervals held together by cross ties, which are bolted to piles driven in the ground. It may be observed of all these plans of construction, though in a less degree of the last, that the "track" instead of affording a uniform degree of support to the wheels, actually consists of a series of short elastic planes, divided by the rigid summits caused by the points of support. The springing of the rails between the points of support gives to the engines, when they proceed with any considerable velocity a bounding motion, and unless precaution has been taken to place the blocks nearer together at the joints of the rails, so as to render the deflections uniform throughout, a very destructive rocking motion is united to the bounding one, or the engine moves with an awkward wabbling gait, which occasions the rapid wear and destruction of the engines railway, and carriages. But, even should the deflections be rendered uniform, still the point of support will present a succession of rigid summits against which the wheels impinge, or in bounding over, bend and even break the rails on the other side. The violence, rapidity, and varied direction of the blows and strains to which each stone block is subject from every train that passes, soon causes them to settle unequally, and to spread apart, more particularly in the curves of the road, so that numerous cross-ties are found necessary to keep the track of the proper width. Hence timber cross-sills are now very generally preferred, as they prevent the spreading of the rails, and afford a less rigid support than the stone blocks. A track constructed on cross-sills, placed at right angles or nearly so, to the direction of the road will soon, however, show many of the defects that are to be observed in the stone block system, while it has others that are peculiar to itself. The sills are usually made from six to nine inches wide on the base and seldom exceed eight feet in length, so that they afford a less extent of bearing surface on the road-bed than the stone block. Much of this bearing is at the middle of the sill, where it has an injurious effect, as the extremities of the sills have to sustain the weight of the rails and the impetus of the moving trains, and having, moreover, a less extent of bearing surface than the middle are soon pressed into the road-bed. The sill will then rock, or spring, on the ballasting under its middle, as on a fulcrum, and will generally recover its former position after the passage of the train, so that it is only in wet weather that this defect can readily be discovered, as the water will then be seen spurting from beneath the ends of the sills when the wheels roll over them. When once a cavity is formed beneath the end of a sill, the evil goes on increasing very rapidly, as the passage of each wheel gives an additional blow to deepen the pit; and it not unfrequently happens from the uneven state of the track, that half, or even more, of the weight of the engine, or carriage, is thrown on the wheel, which thus descends with the accumulated force of gravity, and the momentum of the moving train. The sills that are usually most depressed are those over which the rails join, as they are in consequence acted upon by at least double the weight the others have to sustain. This is a matter of very serious consequence in the best constructed tracks of this description, and much more so in the common wooden keyed track, so extensively used from its cheapness. The sills of this track are frequently only bedded on the natural earth, and the wooden rails, or string-pieces, simply abut against each other in a notch cut in the sill, being there secured by a

wooden key driven alongside of them in the same notch. This imperfect fastening is not even sufficient to resist the warping of the wood, and frequently before the track has been used the end of one rail will be seen elevated above the other; the swelling and shrinkage of the timber with the changes of weather, and the vibrations and jars of the passing trains soon work the keys loose leaving the ends of the rails at liberty. The end of the rail on which the wheel rolls at the instant will be depressed, and with it the sill under its extremity, while the end of the next rail in continuation being at liberty, or only held down by the thin iron plate rail, the fastenings of which being insufficient to resist the elastic force of the timber rail, are thus torn loose, and by repeated bending the iron bar is soon broken short off; the timber rail and ragged bar will then spring up above the surface of the track, causing, perhaps, one of those dreadful accidents that so frequently mark the imperfections of our present railways. The settling of the ends of the sills is obviated to a great extent on the better constructed tracks by placing beneath them a longitudinal piece of timber, usually about eight by three inches thick, known as a "mud-sill," the cross sills will then become merely ties to hold the track together; still the deflections of the rails between the sills will continue as before, and the mud-sill is found to settle, so that the track soon becomes very uneven.

The well known track formed of continuous sills of granite plated with iron might be supposed to afford a uniform and even way, but the stone sills are soon found to settle unequally, and to be crushed, or wear irregularly, while the iron is rapidly beaten out and destroyed, the whole structure being too rigid and devoid of elasticity. The advocates of the stone and iron railway might profit by the experience of the black-smith, whose anvil, they will find, is always placed on a block of wood, in preference to stone; for were the latter used, the anvil, hammer, and stone would soon be shattered: Yet what are the blows of the blacksmith to those of the ponderous locomotive engine?

The degree of elasticity required, will in my opinion, be best obtained by the intervention of a strongly combined timber frame work between the iron surface of the rail-way, and the stone, or natural foundation; and the objection of rapid decay can be removed by kyanizing. The common timber rail is usually made about five by nine inches square; if instead of this and the mud-sill, we take one piece of timber of equal section, or even less, say eight inches square, and embed it throughout on the foundation, we shall have the same area of bearing surface as the mud-sill, and avoid the deflections of the common rail. The joints, however, will still be weak points, and the track must be prevented from spreading.

There is still another very great defect that may be observed, more or less, in all our rail-ways. I mean the lateral derangement which takes place at the joints of the rails, and instead of a smooth and regular straight line, or curve, as the case may be, we see a wretchedly zig-zag one. And the only means, I have seen used to obviate this palpable defect, is to prop the ends of the protruding sills from the sides of the cuts, exhibiting more the appearance of a tottering structure than of a new and permanent work; but even this rude expedient cannot be resorted to on the embankments and we see an abortive attempt made to secure the sills by driving stakes in the embankment at their ends.

I obviate the foregoing defects by uniting the materials of the track in one continued and well knit framing, as represented on the four accompanying sheets of drawings, which represent the principal modifications of the same general principles of construction contemplated by me.

Sheet 1, Fig. 1, is a plan of rail-way track; Fig. 2 a side view; and Figs. 3, 4, 5, and 6 are cross-sections on an enlarged scale. The same letters indicate the same parts in all these figures. When the climate is mild, the soil open, permitting the free percolation of water; or, from induration not liable to be heaved by frost, the road may be simply graded in the usual manner, and plank—*a a a*, &c., of any suitable dimensions laid diagonally on the center line of the track, and crossed by others, *b b b*, &c., laid in an opposite direction, so as to intersect the former on the center line—*c c c c*, &c., where they are subsequently secured to each other by wooden pins, or otherwise; these planks are also, made to cross each other under the rails, as at A B C, F G, B D, &c., on the outside of which the ends of the planks are let project some distance—*a*, *b*, *a*, *b*, &c., so as to have a broad bearing on the road-bed, and on bad bottoms they should intersect again on the outside. The timber rails, or string pieces—*d d d d*—are intended to bear continuously on the road-bed, and when the light iron plate rail is used, I would prefer forming them nearly square and of considerable strength as represented by the cross-sections Figs. 3, 4, 5, and 6—and on Sheet 4, by Figs. 41, and 42. For ease of construction, and to facilitate repairs the string-pieces, and rails should be got of uniform lengths, which ought to be at least sufficiently long to rest on three intersections of the latticed sills, or from A to B; and in laying down the track I generally prefer placing the joints of the string-pieces on the one side opposite to the middles of the

string-pieces on the other side, alternately as represented; F, G, and H being at the middles of the string-pieces, and C, B, and D at the joints. To prevent the end of one string-piece from starting up, or being sunk below the other, and, also, to prevent lateral deviation, I have invented a new method of scarfing. The old half-lap scarf, represented at E, Figs. 1 and 2, and by the section Fig. 6, it will be seen throws great strain on the bolt *h* which soon racks it; to avoid which I devised the scarf represented open at A, and closed at C, B and D. This scarf is, however, too difficult to make, and will not of itself prevent lateral deviations. I have since invented the simple and efficient method of uniting the ends of the string-pieces represented on Sheet 4, which I term my angular scarf. This scarf is shown open at $T^{a'}$ Figs. 33, and 34; and closed at $T^{b'}$, T', &c. This scarf can be formed with the saw alone, and will be most conveniently done in a "miter-box"; a cut is made at any desired angle *e f*—say 45°—which may extend to one-half, or any other proportion of the depth of the piece; it is then turned over and cut down at the same angle, which will on returning it be in the direction *g h*. On bringing together the pieces 1 and 2, the angular lap *e' g'* of 2 will rest on *e g* of 1; and the angular lap *h' f'* of 1 will rest on the similar part *h' f'* of 2; as shown at $T^{b'}$. And the diagonal surfaces *e f*, *e' f'*, *g h*, *g' h'*, being in close contact with each other will prevent all lateral variation. I contemplate the application of this joint, or scarf, to the general purposes of carpentry; making it of any required angle, or, with parallel sides and square ends.

The string-pieces may be secured to the latticed sills in a great variety of ways, as by a bolt *h*, Figs. 1, 2 and 6, passing through the string-piece and through the intersection of the sills, being secured below by a screw-nut, or a key. But, as timber when laid on the earth and exposed to the sun and weather is apt to split, and is then soon crushed beneath the engine wheels, I would prefer securing, at least the scarfs of the string-pieces by a band that would close the fiber of the wood, more especially when the light iron plate rail is to be used.

Fig. 3 is a cross-section on an enlarged scale, taken through C F Fig. 1. At C the two laps of the scarf *e* and *f*, together with the sills *a* and *b*, are tightly bound together by four screws *s*, *s*, *s*, *s*; while the band at F is secured by two screws at top, and a hook *i* together with the key *j* at bottom.

Fig. 4 is a section at B of the plan and side view; here the bolt *l* passes through the two side straps K K and through the scarf of the string-pieces; while below the brace sills the two parts K K are connected by the cross bar *m*, which is hooked at the ends, and the whole is tightened by the key *n*.

Fig. 5 is a section at D H of the plan Fig. 1. The side D is secured at top the same as the last, and the bottom by screw-nuts. At H a method is shown by which the string-piece and two brace sills are firmly bound by two semi-bands *o* and *p*, which are secured together by the hook bar *q*, and to expand it in length it should be heated at the time it is introduced. It will be observed that where the ends of the semi-bands lap on each other their surfaces are counter inclined planes, so that on driving the key *r* the bands will be drawn tightly around the wood in every direction. On Sheet 4 a more simple band is shown; the brace sills being made of broader plank so as to admit of holes being bored through the intersection of the braces on each side of the timber rail, or string-piece, which will be understood by the cross-section Fig. 41, *d* being the string-piece, and *a b* the brace sills; the two ends of the iron strap *i i* pass through both brace plank, and are keyed below, or secured by "screw nuts." And as screw-nuts in such situations are liable to rust on the bolts so that they cannot be either tightened, or taken off, I propose to obviate this defect by having them formed with a cap to cover the end of the bolt, as represented by W, and X, Fig. 39, so as to exclude moisture, and retain a little turpentine, or oil. I also propose to reduce the expense of the formation of these, and other screw-nuts, by casting them of iron, brass, or other metal, in suitable molds with the screw formed in them.

As there are situations where timber is abundant and cheap, and iron work dear, and it may be an object to save expense, large wooden pins of any tough and durable wood may be used to secure the middle of the string-pieces to the brace sills, as represented by Figs. 44, 45 and 42, Sheet 4. Wooden pins have been frequently used to secure the string-pieces to the sills in rail-road construction, but have very generally failed in consequence of having been driven in vertically, the starting of the rail would thus readily draw the pins and afford leverage to break them. Having clamped the brace sills *a* and *b* as tightly as possible to the string-piece, I bore through the whole at about an angle of forty five degrees in one direction, and again in an opposite direction, so that the pins when driven will make with each other nearly a right angle. By the use of large sized string-pieces, not liable to split, and the angular scarf T, &c., the pins might, also, be used at the ends, as at T *p p*, &c., Figs. 44 and 45, in which case I would prefer spiking a strip of hard wood *x x*, &c., Figs. 44, 45 and 42, on the string-piece, on which the iron plate rail would be laid, the spikes *s*, Fig. 42, passing through the strip

and into the string-piece. In every case the pins at least should be kyanized.

The track on Sheet 1 is represented as prepared for the light iron plate rail by having the part *i* cut out; but, I would prefer making it flat on top, as just described, with a strip of hard wood spiked on, which could at any time be removed and replaced by a heavy iron rail, of a similar section to those represented at Figs. 7 and 8.

The rail-way tracks I have described are constructed with a double set of braces, which cross each other on the center line; cross-sills may, however, be combined with the braces as at $Q^{c'}$ $Q^{c'}$, Figs. 33 and 34, and at U, U, &c., Figs. 44 and 45,—or a track may be constructed with a single set of braces like those represented on Sheet 4—*a b*, Fig. 46; or combined with cross-sills T U.

The following methods will show how the track may be united by means of wooden keys: Sheet 3, Fig. 26, is a plan of track; Fig. 27 a side view; and, Fig. 28 a cross-section at O K of the plan. The brace sills run diagonally from the joint of the rails on the one side to the two joints on the other side. Thus, the rails I K, the cross-sills L M, and the braces L I, L K form together a "king-post" truss, and on the other side of the track there is a counter truss; and so on in continuation, the next truss being on the first side; every rail in the track will thus be trussed, and every scarf will be braced and tied to three points of the opposite rail. These rails, or string-pieces, can, of course, be secured to the sills by bolts, bands, or pins, as herein before described; but, the method here adopted, which is best shown by the section Fig. 28, is to cut mortises, *a*, *a'*, *b*, *b'*, through the cross-sills, Fig. 26, into which fit the key pieces *c*, *c'*, and *d*, *d'*; the former have each a shoulder *e e*, which goes below and secures the brace sills *f* and *g*; while above the sills, the surfaces of the key pieces incline to each other at top *h i*, and thus embrace the rails K *l*, which are cut in for the purpose; the whole is tightly secured by driving the wedge formed key *m*. The pieces *d' d*, which secure the middle of the rails to the cross-sills, are similar above the sills to the others, but below they may be secured by cross keys, or even round pins *n n*.

Sheet 4, Fig. 46, will illustrate other methods, contemplated by me, of uniting the timber frame work of the track so as to give full effect to the braces, both as "struts" and "ties," without the use of iron work. The string-pieces, or rails, *d d*, &c., are large timbers having a continuous bearing on the road bed, and being connected at the ends T T, &c., by means of my angular scarf, are pierced with a mortise near each end, through which pass the diagonal braces *a a*, *b b*; each brace has two notches *c c'* cut on opposite sides, and is secured in its place by the keys *e e*, &c. The braces cross each other in this case on the outside of the rails, where they may be secured to each other by pins, keys, or otherwise, and, also, combined with cross-sills, as at T U, &c. These braces may, obviously, be made to cross each other on the inside of the track, and a double set used if desired.

Any of the usual iron rails may be laid and secured with the usual fastenings on my timber tracks; but, I contemplate giving great additional strength to the track by selecting and combining a suitable iron rail with my timber frame work. I would prefer for this purpose a broad base parallel rail, capable of having a continuous bearing, similar to the rails represented in the sections Figs. 7 and 8, Sheet 1.

On Sheet 3 one of my methods of constructing my united brace track is represented. Fig. 29 is the plan of track; Fig. 30 a longitudinal side view; Fig. 31 a cross-section at Q Q of the plan; and Fig. 32 a cross-section at S T of the plan; the same letters are used on the four figures. Having latticed the sills A A, &c., B B, &c., as described in Fig. 1 and placed the scarfs T T, &c., of the string pieces D D, &c., alternately opposite the middle, S S, &c., of the string pieces on the opposite side of the track, I place the middle of the iron rails, consequently their strongest and stiffest part, so as to bridge over the scarfs of the timber rails, or string pieces; the iron rails being made of regular lengths, their joints will thus be placed on the middle of the timber string pieces, as at S S, &c., and, also, alternately opposite the middle of the iron rails on the other side of the track. In fastening the iron rail to the timber frame work, it should be done by such means as will admit of the contraction and expansion of the iron bar; but, that this motion may be the least possible, the bar should be fixed at the middle of its length; this I effect in several ways; the method represented in the present case will be better understood by the cross-section Fig. 32, taken through T S of Fig. 29; the side T in the section being through the middle of the iron rail and scarf of the timber ones. A notch is cut in the base of the iron rail on each side at the middle of its length, into which fits the two horns *m*, *m* of the wrought iron cross-bar or narrow chair *l l*; these horns are represented open on Sheet 4, Fig. 7, *m m*, over which is seen the rail ready for insertion. Having framed the track, or whenever it is desired to secure the rail to the cross bar *l l*, the latter is removed and heated to redness, the rail is then inserted and the horns *m*, *m* hammered down on the base of the rail, as at Fig. 32, and on cooling they will contract tightly on the rail; it is then secured to the timber

frame work by the screw nuts *c c* on the two bolts *a a*, which latter pass through both the brace sills A and B, and may be secured below by a single key *b b* notched in as represented; or by screw nuts as above; or, dispensing with the bolts *d d*, by having a common head on the bolt *a a*. The bolt *d d* passes through the two bolts *a a*, and through the two laps *e f* of the scarf of the string pieces, the joint being vertical. For the intermediate fastenings, as at Q Q, the horns *m m* have sufficient width between them to receive the whole base of the rail, and may be driven on from one end. I prefer making the joint chairs at S S, &c., of wrought iron, also; constructing them in the following simple manner: Sheet 1, Fig. 14, represents a flat plate of iron of any suitable thickness, in which four cuts *i j*, *i j*, &c., are made with a saw, or otherwise, leaving a space *j j* in the middle about equal to the base of the rail; the iron being heated in the usual manner of working wrought iron, the parts I, J, K, H, are bent up in the form of the section of the rail; as represented by the end view Fig. 16; and the plan, Fig. 15. These chairs being heated, will expand sufficiently to admit the rail, and on cooling will hold it by an elastic pressure, that will permit the expansive and contractile motion of the railway bar; and as they are formed of the same metal as the rails, their rate of expansion and consequently pressure on the latter will continue uniformly the same at different temperatures; unaffected, also, by wet or dry weather. And as these "chairs," moreover, are formed of a tough material they will be much less liable to break than the cast iron ones. Should there be any discrepancy in the size of the rail-way bars, it can be readily adjusted by heating the chair, as before described, and hammering in, or out, as may be required, either pair of wings J H, or I K, until the inner edge of the rails, next the flanges of the wheels, are quite even; more room should however, be allowed for the base of the rail than is shown in the figures; and if one rail be higher than the other, it will only be necessary to force the higher rail into the chair a little farther than it will ever go by expansion, and to hammer down the surface of the high rail until both are even; either embedding the base of the rail in the bottom of the chair, or setting the bottom of the chair lower under the high rail, and embedding it in the timber. All of which will be readily understood and executed by any good workman. This "chair" is shown at S in the cross-section, Fig. 32, Sheet 3, and is secured like the middle "chair" by two bolts *a a* that pass through the intersection of the sills A B.

This track, it will be seen by the drawing, is put together with screws, so that any part can be removed with great facility to make repairs; or tightened when necessary on the fiber of the wood; and as these screws would be liable to rust, screw-nuts with a little cap to contain oil, &c., and exclude moisture, as before described, Fig. 39, should be used in preference to those represented. The "chairs" of wrought iron, (or any malleable metal may be used) hereinbefore described, that admit of motion in the rails, while they hold them tightly, effect that desideratum by a metallic spring pressure, which method of holding railway bars I claim to have originated, and as said spring pressure may be variously applied for producing the intended effect, I claim its application for the objects herein set forth, whether it be effected by means of a wrought iron "chair"; or as it may be united, and applied by a cast-iron one. And that others skilled in the art may know how to use it in connection with the cast iron "chair," I will proceed to describe the method I consider best.

Sheet 2, Fig. 21, is a section of the rail, and an end view of the chair; R is the railway bar; C C, &c., is the end of the cast iron chair; and B is the spring headed bolt that secures the rails to the chair. Fig. 22 is a plan of the chair, and joint of the rails, which joint is represented to be diagonal, but may be made at right angles, or otherwise. Fig. 23 is a horizontal section taken through Fig. 21 on the line A D. The chair C C, &c., is made of cast iron, into which the rails fit loosely; the lip *a* being merely added to secure the rail, in case the spring bolt B were broken or removed. The end of each rail has a piece cut out, so that the shank of the bolt B will pass between them, and through a suitable hole in the back of the chair at *c*, where it may be secured either by a screw nut, as represented, or by a notched key. The spring pressure movement is here applied by making the head of the bolt B very long and narrow, and bending it so that the extremities of the head at *b b* will first come in contact with the inside of the rails, and press them against the back of the chair *c c* as the nut *d* is tightened. When great pressure is required on the rails, I would make the head of the bolt of a combination of steel and iron; the external part of the head *e e* being spring steel welded to the wrought iron bolt *b* B *b*, and tempered as usual for springs; the iron being united to the steel to prevent breakage from sudden jars. But, in most cases a simple wrought iron bolt the head of which has been "hammer tempered" will have sufficient spring for the purpose. These "chairs" can be used at any part of the rail by having suitable holes in the latter for the shank of the bolt to pass through; allowing room, also, for the expansive and contractile motion of the rail.

Cast-iron chairs with spring headed bolts,

as above described, are represented as applied at the joints of the rails; and wrought iron ones at the middle of their length on the plan of a rail-way track Fig. 19, Sheet 2, which is another mode in which I have contemplated the application of my improvements. Fig. 18 is a side view without the brace sills. And Fig. 17 a cross-section at I K of the plan in which they are, also, omitted. At K is represented the scarf I at first designed for the timber rails; which is represented open on Fig. 1. The middle of the iron rails at K, Figs. 17, 18, and 19, is securely banded to the scarf of the timber rails by the iron bands *i i* secured by screws to the wrought iron chair *l l*. And on the opposite side of the track to the scarf is placed the middle of the timber rail, which is made to support the scarf laterally by means of the tie bar I K, which passes through the middle of the rail at I, and the scarf of the rails at K, and is united to both by screw nuts, as represented. The middle of the timber rails at I, also, supports the cast iron chair, on which the iron rails join; as hereinbefore described; and between this and the middle of the iron rail, it may be secured to the timber by common spikes, or by large "wood screws;" but when such means are used I would prefer letting the base of the iron rail into the timber one, or string piece. My general method of combining the iron rails with the timber string pieces, so as to form a rail of continuous bearing, will be understood by the description I have given of the two last tracks; this at Figs. 17, 18 and 19 I had designed before I invented the brace sills *a c a*, *b c b*, which were subsequently added to it; as it may be remarked of the track, Fig. 19, that however strong the combination was without them it would not effectually prevent lateral deviations, which might be occasioned by the warping of the timber, to which consideration may be added the greater extent of bearing surface the sills have on the road; and, being covered by the ballasting will hold the rails down. Their union, also, with each other, and with the string pieces and rails forms a plat work of great strength and simplicity. At L M of Fig. 19 a cheaper tie bar is shown, and by the section Fig. 20; but with the brace sills *a c a* and *b c b* the tie bars are superfluous, and may be dispensed with entirely.

On Sheet 4 I have shown other original modes of securing the iron rails to the timber string pieces and latticed sills; also, variations in the application of the latticed sills, and their combination with cross sills, besides a different relative position of the joints in the rails, &c. Fig. 33, is another plan, or ground plot, of my united brace railway; Fig. 34 is a side view of the same; and Fig. 35 is a cross-section, on three times the scale, taken through the iron rail, the string piece, and brace sills at *p* near T′ of the other two. The timber frame work A′ A′, B′ B′, D′, D′, &c., is the same as that at Fig. 29 with the exception of the string pieces D′ D′, &c., which in the present case are made broader and thinner, by which a more extensive bearing on the road bed is obtained; they are, also, united at the ends by my angular scarf $T^{a\prime}$, $T^{b\prime}$, T′, &c. The middle of the iron rail at T′ is also made to pass over the scarf, and is secured to the latter, and to the brace sills, in a way that is not only more simple and cheap, but that will give great additional strength to the structure; two holes *o o′* are drilled in the base of the rail, one on each side the middle of its length, so as to leave a space between them of ten or twelve inches; and I would prefer placing one hole on each side of the center rib of the rail, and as close as possible to it, that the bolts *p p′* may be placed entirely under the top table of the rail, and, thus, be out of the way of the flanges of the wheels, as shown in the section, near T′, Fig. 35. The bolts *p p′*, it will be observed, pass both through the base of the iron rail R′, one of them through the end of each string piece D′ D′, and both through the two brace sills A′ B′, at their intersection. Above the base of the iron rail they are secured by notched keys *u u*, or by common split keys; and below the brace sills either by keys, or by screw nuts.

At the joint of the iron rails the malleable iron chair, hereinbefore described, is used and secured by two bolts *q*, *q*, that pass through the timber string piece and the two brace sills A′ and B; these bolts can be secured either above or below by keys, or screw nuts. The string pieces D′ D′, &c., are represented without the iron rail from $T^{a\prime}$ to $S^{b\prime}$, where the end of the rail R′ is inserted in the joint chair; the indentation made in the string piece to receive the joint chair is shown at $S^{a\prime}$; and, *t t* is the groove cut in the string pieces to receive the base of the iron rails, which I consider necessary when spikes *s*, *s*, &c., or wood screws are used to secure the iron rail; but, I would prefer securing the iron rail at the intermediate point Q′, Q′, &c., by a small malleable iron chair, in which case, the groove *t t* in the string pieces may be dispensed with. I would prefer securing these intermediate chairs by two bolts also, see Fig. 37; but for economy they may be made as shown by section, Fig. 36, which is secured by a single bolt; or, the rail may be secured in the wrought iron chair *y* by my improved screw-nut *x*, one of the horns of the chair being cut with a screw to suit Fig. 38, in which case a single bolt *z* may be used; there should be an oblong spring washer under the nut, to keep it from unscrewing. And Fig. 40, shows how

the "bridge section rail" may be secured by single bolts throughout, and the rail kept from spreading by the wrought iron chair *c c*, *r* being the rail.

At Figs. 33, 34 and 36 Q^c Q^c is a cross sill; showing how cross sills may be united with the brace sills A′ B′; the string pieces D′ D′; and the iron rails R′ R′. The iron rails might be laid directly on the combination of sills A B, &c., without the string pieces D′ D′, but the track would not be as good, even with a mudsill below them.

In the tracks I have hitherto described, it may be observed with regard to the arrangement of the joints in the rails and string pieces, that a cross section at T′ S′, taken through any one of them, would pass through a joint of the iron rails on the one side, and a scarf of the string pieces on the other. But, I contemplate arranging them, in some cases, so that a cross-section can pass but through one joint or scarf. This I effect without any alteration in the structure of the combined rail that constitutes either side of my united track; but simply by making the joints and scarfs in said rail on the one side to quarter with those in the "combined rail" on the other side. That is the joints S″, &c., and scarfs T″, &c., Fig. 43, on the one side of the track are placed opposite the intermediate points Q″ Q″, &c., on the other side. The track may now be united by a single set of brace sills extending between T″ T″, T″ S″, S″ S″, and S″ T″, &c., but I much prefer crossing them by other sills uniting the points Q″ Q″, &c.

For ease of construction, and facility of repairs, I would recommend that all the rails, both of timber and iron, for the straight lines, and, also, those for the outer side of the curved track, be made of one uniform length when measured in the track, which is exclusive of the allowance on each for the joint or scarf, while those only for the inner side of the curves be shortened proportionally to suit the degree of curvature.

My railway tracks may be laid on any variety of soil, even the quick-sand and the moss, by increasing the bearing surface; and on stiff clays if heaved by frost it will settle evenly; but, it will be much better to avoid this derangement by grading the road in clay high on the center line C, and sloping off on each side A B, Fig. 17, and having rendered the surface compact and even with a heavy roller, to lay on it a course of rubble stone filled to a level line D E, Fig. 17, the outer edges A, B, being supported by a cordon of large stones; the surface D E should be well rolled, and a uniform course of gravel, or finely broken stone laid on it, which should, also, be well consolidated with a heavy roller. On the surface so formed, I would bed the track, ramming "ballasting" of gravel, sand, or finely broken stone under the top sills and rails; and, also, covering the latticed sills with the ballasting, so that nothing is seen above the surface of the road but the two lines of rails.

I contemplate, in some cases, using cast iron rails of any suitable form on my timber tracks. And, I, also, contemplate making the lattice work of iron bars; and embedding the track in a pavement of coarse sand united by asphaltum mastic, or other tough cement.

What I claim as my invention, and desire to secure by Letters Patent, is:

1. Placing the sills *a c a* and *b c b*, &c., Fig. 1, &c., A and B, Figs. 29, 33 and 43, in the formation of a railway, so that they will cross each other in lines diagonal to the rails; and uniting them with each other, and with the rails so that they become struts and tie-braces to the track, substantially as set forth. And whereas, said brace sills may be variously combined with each other, and with cross sills, as at Figs. 33, &c., 44, &c., and 46, &c., and may be made to support an iron rail without the intervention of the timber string pieces; and may, also, like common sills be placed on a "mud sill," I distinctly claim to be the inventor of the braced sill, or latticed construction of railway tracks under the modifications set forth, together with such variations thereof as may produce a like result by means substantially the same. I thus by the union in one, to an indefinite extent, of such materials as those that usually compose railway tracks, obtain by a united framing, a more extensive and uniform bearing on the soil than the individual parts would have; all other railways having to depend on the uniformity of soil, or artificial road bed, for their evenness of surface. Whereas my railway track, herein before described, is independent in its formation of the soil on which it rests.

2. The method of uniting, or scarfing, the string pieces, substantially as represented at A and B, Figs. 1 and 2, &c., and in Figs. 33 and 34, Sheet 4. And whereas said scarf can be used with great advantage to unite the ends of large timbers in foundations, piers, bridges, and other structure, I distinctly claim its application to the general purposes of carpentry.

3. The method of evenly joining, and holding railway bars by means of a metallic spring pressure, so as to permit the contractile and expansive motion of the railway bar, whether said spring pressure operates by means of my malleable iron "chairs" described, or as it may be variously modified and united with cast iron "chairs," as herein described. The application of a spring to the rail for the purpose described being in itself new, and as said spring may be va-

riously applied for producing the intended effect, it is to be distinctly understood that I claim the employment of a spring under the various modifications thereof described; and whenever it operates upon the principle and produces the effect in the manner set forth.

4. The method of holding the iron rails at the middle of their lengths as set forth, and represented in Figs. 17, 18 and 19; also, in Figs. 29, 30 and 32; and in 33, 34 and 35; by which the iron rail is made to support the scarf of the string pieces, or to form a part of the splice, as herein before described.

JAS. HERRON.

Witnesses:
CHS. M. KELLER,
B. M. BYRNE.