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TRACKWORK MACHINES FOR RAILROAD TRACKS AND
IMPROVED METHOD OF OPERATING SAME

Filed May 2, 1966

Sheet 1 of 4



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May 20, 1969 E. OVILLE ET AL 3,444,822
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Filed May 2, 1966 Sheet 2 of 4

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Sheet 2 of 4



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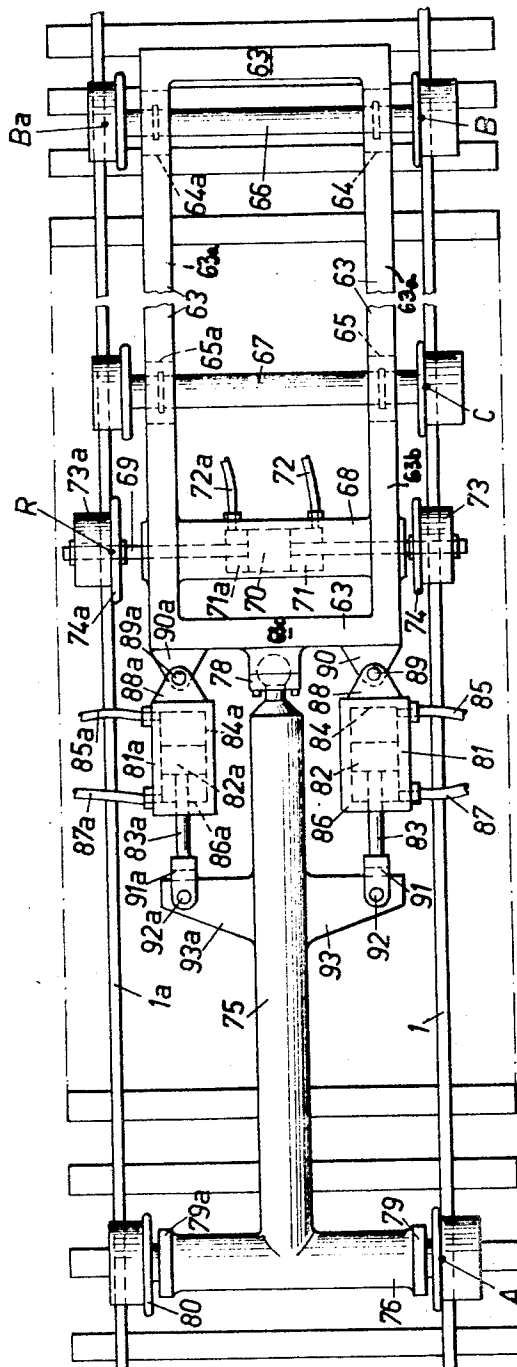
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Sheet 3 of 4

Fig. 4



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Sheet 4 of 4

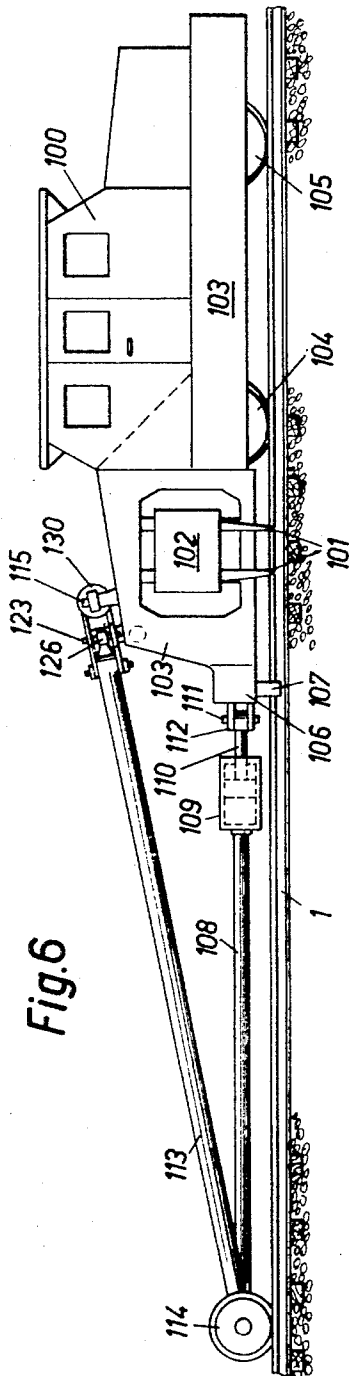


Fig. 6

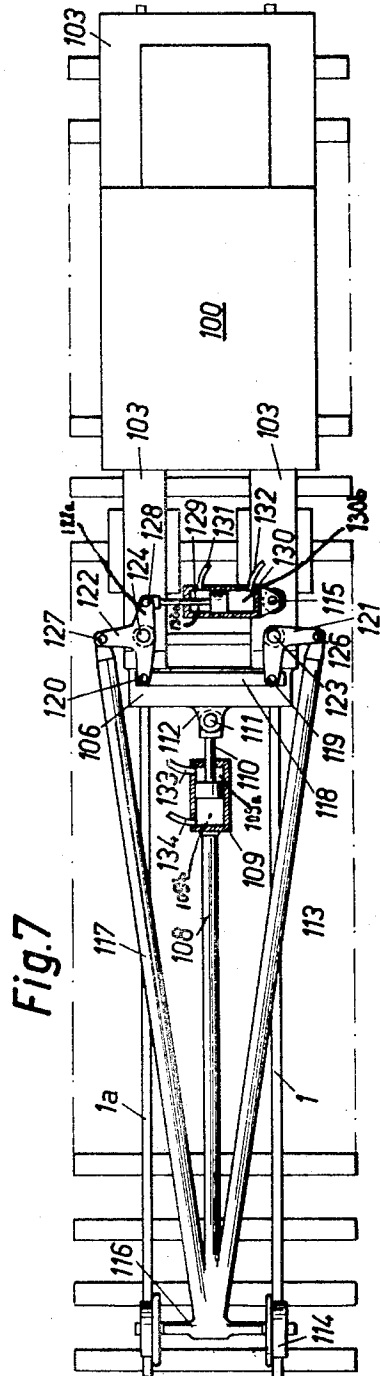


Fig. 7

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TRACKWORK MACHINES FOR RAILROAD TRACKS AND IMPROVED METHOD OF OPERATING SAME

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20 Claims

ABSTRACT OF THE DISCLOSURE

A trackwork machine for railroad tracks incorporating two frame units which are articulated to one another, with such frame units bearing upon the railroad track at least at three axially spaced locations. At least one of such frame units carries tool means at a location intermediate the outermost bearing locations of such frame units upon the railroad track, and means are provided for applying a force to at least one of said frame units to cause said frame units to arch in order to selectively relieve the bearing pressure exerted upon the railroad track at least at the bearing location in the neighborhood of the aforesaid tool means. The invention also pertains to an improved method of operating such trackwork machine wherein there is applied a force to at least one of the articulated frame units in order to cause the aforesaid frame units to arch so as to selectively relieve the bearing pressure in the manner explained above.

The present invention concerns all type of trackwork machines for railroad tracks which are designed to carry out simple or complicated maintenance or renewal operations such as tamping, ramming, ballast removal or excavation, lifting, slewing or shifting along the track individual rails, the track structure itself, or pre-assembled track sections. This invention further pertains to an improved method of operating such trackwork machines in order to adjust the bearing force exerted thereby, at least at a predetermined location, upon the track.

The present invention is particularly applicable to high performance machines which, in order to balance their dead-weight and/or the forces exerted by the corresponding tools, such as picks, clamps, chains and so forth, apply pressure on the rails both vertically and horizontally in planes transverse to the track. Generally, these contact forces must be maintained within given limits, not only for reasons of safety, but also to prevent them from exerting a harmful effect upon the operation of the machine or, in fact, making such work impossible. If it is attempted to spread out the pressure areas along the track, then it is soon found that such will be limited by the maximum permissible wheelbase between the axles which is a factor of running requirements.

In the category of two-axle machines or equivalent arrangements tampers are already known wherein the tools thereof are arranged either between the axles or at a projecting portion of the machine frame, in other words, foreslung. These tools which generally always vibrate are located close to the loaded zones and there are often set up abnormal settlement of the ballast beneath the cross-tie or sleeper, or also bring about disalignment of the track when the machine is working in curves or one side of the track is higher than the other. The running surface can therefore be completely put out of true.

Moreover, the aforementioned ballast settlement becomes that much more serious when the tamper directly

2

carries track-lifting equipment and as a result corresponding forces are added to the former ones.

In the frequent situation of a tamper with foreslung tools and where the forward portion of the machine additionally carries track-lifting equipment the ballast settlement during working can become of such proportion that it makes adequate lifting of the track impossible, even if a counterweight is provided at the rear end of the machine in order to balance the pressure upon the supports to some extent.

The modern levelling-tampers which work while travelling along the track are often of this latter type. They are particularly affected by such settlement since it occurs in an irregular and haphazard manner from one cross-tie to the other. Machine performance and accuracy of the work is what directly suffers. The provision of a counterweight does not overcome this difficulty.

Furthermore, it should be stressed that every loading—even by a very small force—causes an elastic, i.e. non-permanent, deformation of low amplitude yet extending over a very great length. This disturbed area brings about errors in the geometric measurement of the track which are all the more pronounced as the elasticity changes from one area to the other, especially when passing joints and as the pressure loading varies with the employed lifting force.

In tampers with foreslung tools on two axles and which carry at the forward end double equipment for lifting and slewing, in addition to the drawbacks previously mentioned, there are also encountered those arising from the slewing force. A large horizontal movement is impossible because the front axle acting in the opposite direction on the track causes it to go out of alignment. If, in order to overcome this disadvantage, the front axle is given further loading in vertical direction, for example by lifting the track, then the loading on the rear axle is lightened, causing the track to go out of alignment but in the opposite direction. As already mentioned, this additional loading is limited owing to the settlement of the ballast.

With machines known under the designation levelling-lining-tampers (or levelling-slewing-tampers), an elastic deformation of the rails and of the track is produced in the horizontal plane, analogous to that previously considered, and which owing to its length, its irregular elasticity and the very variable slewing force, destroys the accuracy of the machine.

It is particularly emphasized that the slewing force is always accompanied by a twisting torque which increases certain vertical loading and unfavorably influences the accuracy of this type of machine. To this there must be added the disturbing effect of their own weight when working in curves, and as has already been mentioned.

Levelling-tampers on two axles with fore-slung tools have already been proposed wherein the rear end of the machine is equipped with a pivotable arm fitted with rail clamps and pivoted by power for slewing the track. Here again, there is provided the foreslung arrangement of the slewing tools, this time however at the rear end of the machine, and therefore encounters exactly the same disadvantages, still increased for the reason that a very heavy machine exists and, above all, lining of the track must be undertaken behind the levelling and tamping location which is very disadvantageous from the standpoint of the final track position.

Several types of machines exist for slewing the track, or a parallel neighboring track, by means of a pivotable arm or frame, the function of which is identical with the previously mentioned arrangement. Moreover, such machines are closely allied to the well-known railway cranes. With such there always occurs an overloading of the axle closest to the work tool.

To the prior art there also belong levelling-tampers with foreslung tools on two axles which carry an arm equipped with the slewing device. This arm is mounted at the forward end of the machine and bears further forwardly upon an auxiliary trolley. In this arrangement a large portion of the slewing force is transmitted to the foreslung frame of the machine, which, as above, results in lateral loading of the axles and subsequent track misalignment.

Levelling-tampers have also been equipped with two auxiliary frames or beams bearing upon two trolleys, one placed between the two axles and the other in front before the beginning of the elastic bending line of the raised track. Two vertical jacks bear upon the central region of each frame or beam in order to support the foreslung portion of the machine and thus to relieve the front axle. These various components are only articulated to one another, so that the track is heavily loaded by the trolley located between the axles.

In the field of the so-called independent slewing machines which only serve for a lining of the track and which work with or without vibrations or impact, the slewing device is sometimes placed between the two axles. The extent of the slew is limited by the wheelbase. Furthermore, uncontrolled disalignment can occur beneath one or the other points of pressure, depending upon frictional conditions existing perchance between the cross-ties and the ballast.

Mention is also made of ballast-removal machines which are generally provided with ballast-screening equipment. Their ballast-excavating or removal chain or any equivalent tool means can be arranged either between both axles or externally thereof. Also in this case, the wheelbase can limit the desired lowering depth required for the track, the forces exerted for ballast removal can cause displacement of the track, and so forth.

Moreover, railroad vehicles have been known for quite some time wherein the frame of which is separated into two or more rigid elements articulated with one another, for example bogie vehicles, bissels (pony trucks), and so forth. This is done in order to obtain the best possible load distribution, not only in curves and with changes in gradient, but also along flat stretches of track. Certain trackwork machines are of this type. The presence of two or more loaded intermediate supports or pressure areas restricts the possibilities and performance of the machine for the reasons already explained. The main frame must be of great length. Its middle portion is considerably off-set in curves and the there-positioned working of the tools is impeded. The equalization or distribution of the vertical loading generally requires the drive to be spread over several axles, in other words, a very costly construction.

In this connection, it may be remarked that distribution of the dead-weight over the axles, whatever their number, may be satisfactory during travel but can be extremely disadvantageous when the machine is working.

There is still to be mentioned the proposals for reducing the aforementioned pressure forces which—apart from the previously mentioned counterweights, the effect of which is null in the horizontal plane—embody apparatus bearing upon the ballast itself. The disadvantages of such type devices have been stressed many times.

Therefore there is a definite need in the art for a trackwork machine capable of loading the rails to a greater or lesser extent in planes transverse to the track, whereby at the same time there is provided an extended zone or area which is practically free from the disturbances brought about by these forces particularly when the tool or tools are operating.

Accordingly, it is a primary object of this invention to provide an improved trackwork machine which fulfills the aforementioned objective.

Another important object of this invention relates to an improved trackwork machine which overcomes the

disadvantages present in the prior art structures previously considered.

Still another equally significant object of this invention has reference to an improved trackwork machine enabling selective regulation of the bearing force exerted upon the track in both vertical and horizontal direction and particularly at the region of the tools or tool.

Yet a further object of this invention has reference to an improved method of operating a trackwork machine to bring about effective adjustment of the load exerted by the machine on the track.

In order to implement these and still further objects of the invention which will become more readily apparent as the description proceeds, there is contemplated a trackwork machine for railroad tracks which is of the type incorporating at least one tool-carrying frame arrangement and formed of at least two frame elements articulated with one another in order to bear upon the track in a vertical and/or horizontal plane at three areas spaced from one another along the track, wherein the tools or tool means are arranged at the frame arrangement at a location which is disposed between the extreme bearing points of such frame arrangement upon the track.

Characteristic of the machine designed according to the teachings of the present invention is that it incorporates at least one jacking mechanism operatively coupled with two of the aforementioned frame elements in order to prop or arch them against one another in that each is caused to carry out a rotational movement in opposite directions, to thereby adjust the bearing force upon the track of at least one intermediate bearing point in the area of working of the tools.

Other features, objects and advantages of the invention will become apparent by reference to the following detailed description and drawings in which:

FIGURE 1 schematically illustrates a side view of a first embodiment of inventive machine for lifting the track;

FIGURE 2 is a top plan view of the machine depicted in FIGURE 1, partly in cross-section, taken along the line 2—2 thereof;

FIGURE 3 schematically illustrates a hydraulic circuit diagram for the machine of FIGURE 1;

FIGURE 4 is a schematic top plan view of a second type of machine used for slewing the track;

FIGURE 5 is a schematic hydraulic circuit diagram used with the machine of FIGURE 4;

FIGURE 6 is a further embodiment of machine, known as a levelling-lining tamping machine, and viewed from the side; and

FIGURE 7 is a top plan view, partly in cross-section, of the machine of FIGURE 6.

Describing now the drawings, and initially considering the trackwork machine of FIGURE 1, it will be understood that reference character 1 designates one string of the rails of the track upon which the machine can travel, the other rail 1a being visible in FIGURE 2. The main chassis or frame of the machine is formed by a horizontal frame member 2 formed of welded U-shaped iron girders or the like. Two transverse supports 3 and 4 are welded with this frame member 2 which carry at each side of the latter a respective lifting jack, only one of which is visible in FIGURE 1. Each lifting jack comprises a cylinder 5 swivelably mounted through the agency of a shaft 6 passing through both of the transverse supports or bearing blocks 3 and 4. The lifting jack which is not visible in FIGURE 1 also is provided with a cylinder 5a mounted in like manner by means of a shaft 6a, as best seen by referring to FIGURE 2. Inasmuch as the physical structure of both jacks is the same, only the lifting jack visible in FIGURE 1 will be described in any great detail. Specifically, in the housing or cylinder 5 thereof there is slidably mounted a piston 7 with piston rod 8. This piston 7 divides the inner compartment of the cylinder 5 into two chambers 9 and 10. Pipes or conduits

11 and 12 communicate with these chambers 9 and 10 respectively. The lower end of the piston rod 8 is pivotably mounted at a shaft 13 retained in both of the eyelets 14 and 15. These eyelets or mountings 14 and 15 are welded to a housing 16 containing a conventional well-known mechanism for operating the rail clamps, only the hook 17 of which is visible in the drawing.

The frame member 2 is supported by two bogies. Each such bogie embodies a rectangular frame 18, the side members 18a of which are welded or otherwise affixed to the frontal plates 19 and 20. The two axles 21 and 22 of each of the two bogies bear upon the rail string 1 of FIGURE 1 at the points designated by reference characters A, B, C and D, whereas the lifting hook engages at L beneath the head of the rail 1.

One of the two bogies, in this case the one at the right of FIGURE 1, carries a transverse plate 23 which is welded to both longitudinal side members or supports 18a. This plate 23 is provided with a central hole or bore which receives the vertical pivot pin 24 (FIGURE 1) for a bifurcated member or fork 25 formed with the upright arms 26 and 26a. A support 27 is mounted between the forked arms 26, 26a and is welded to a plate 28 which, in turn, is welded to the end of the chassis or frame 2. A horizontal shaft 29, perpendicular to the frame member 2, piercingly extends through the support 27 and the two arms 26, 26a of the bifurcated member 25. The front of the frame 2 is thus supported at its central region or plane by a Cardan coupling, ensuring the freedom of movement necessary for the bogie and at the same time preventing the frame 2 from tilting.

The other bogie likewise exhibits a transverse plate 30 interconnecting both of the longitudinal side members 18a of this frame 18. Here, however, this plate 30 carries at its central region a ball and socket joint 31, 32 wherein the cage or socket 32 is fixed at a transverse plate 33 integral with the chassis or frame 2. The latter is therefore movably supported at all sides.

Above the first-described bogie or frame unit at the right of FIGURE 1, there is provided a special cylinder-piston arrangement, i.e. a jacking device, which on account of its similarity to the action it produces can be considered as an arching jacking device. This jacking device which is therefore used for arching, as will be further explained shortly, incorporates a cylinder 34 slidably receiving a piston 35 and piston rod 36, once again two cylinder chambers 37 and 39 being formed by the aforementioned sliding piston 35. The cylinder chamber 37 receiving the piston rod 36 and thus has the smaller cross-section is provided with a connecting pipe or conduit 38 and the other cylinder chamber 39 with a connecting pipe or conduit 40. This cylinder 34 is affixed to the plate 28 and is in line with the axis of the vehicle, vertically above the support 27. A cable 41 is secured to the free end of the piston rod 36 and is trained over a deflecting roller 42 and anchored to the center of the frontal plate 20. The shaft 43 of this free-running pulley or roller 42 piercingly extends through a bifurcated support 44 secured in the center of a cross-member 45 welded to the longitudinal girders of the frame 2.

At the other end of the depicted vehicle there will be recognized a second special jacking mechanism for arching. Such embodies a cylinder 46 containing a sliding piston 47 wherein such members cooperate to form a single cylinder compartment or chamber 48 having a connecting conduit or line 49. This cylinder 46 is vertically arranged at the center of a frontal plate 50 welded at the end of the frame unit or member 2. The base or free end of the piston 47 is advantageously rounded and bears upon a transverse plate 51 interconnecting both of the longitudinal side members 18a of this frame unit 18 or bogie.

A cabin 150 is shown in phantom lines upon the chassis or frame member 2 in which there are disposed all of the necessary components of the usual type required for operating the machine, such as drive motor, pumps and so

forth. Since these components are standard hardware for such machines and of well-known structure, further details thereof are not here given, particularly since such is not necessary for the understanding of the underlying principles of the invention.

The portion of the view of FIGURE 2 appearing in cross-section, and taken along the line 2—2 of FIGURE 1, provides a clearer showing of the Cardan coupling previously described. Moreover, in FIGURE 2 some of the companion elements for those described and shown in FIGURE 1 can clearly be seen and in this case such have been generally designated with the same reference numeral plus the additional reference character or letter a.

FIGURE 3 schematically depicts the hydraulic circuit for the embodiment of machine shown in FIGURES 1 and 2 and specifically for the jacking device at the right of FIGURE 1, wherein here also the same reference characters have been used to identify such. This hydraulic circuitry incorporates a suitable pump 52 which by means of the conduit 54 sucks oil or any other suitable medium out of the tank or reservoir 53 and forces such under pressure into the conduit 55. This conduit or pipe 55 branches, as shown, on the one hand in the direction of a pressure regulator 56 adjustable by means of a hand-wheel 57 for returning the oil via the line or pipe 58 back into the tank 53 and, on the other hand, branches to a distributor 59, the three-way rotating piston or valve 60 of which is operatively connected with a handle 61 movable in the direction of the two arrows depicted in this figure. A return line or pipe 62 connects the distributor 59 with the conduit 40 and the tank 53.

The mode of operation of the structure described in FIGURES 1 to 3 is as follows: In the position of the machine depicted in FIGURE 1, the two arching jacks previously described are assumed to be ineffectual because their connecting conduits 38 and 40 as well as 49 are in free connection with the tank 53, as will be described in greater detail shortly. At the same time it is also assumed that both lifting jacks for the track are ineffectual because their connecting conduits or pipes 11 and 12 are also in the free flow position. The rail clamps grip the rails and maintain the housing 16 with its mechanism in rest position. Under these circumstances, only the dead-weights come into play and primarily load the string of rails 1, 1a at the intermediate bearing points B and C.

Now by means of the feed conduit 38 a certain pressure is introduced into the cylinder chamber 37. The piston 35 tensions the cable 41 which, in turn, upwardly pulls the plate 20 and at the same time therefore applies more load to the Cardan coupling 26, 26a, 27. The bogie at the right of FIGURE 1 which supports this Cardan coupling and the frame 2 arch in relation to one another. For this reason the contact pressure at C is diminished.

By appropriate increase of the pressure in the chamber 37, it is possible in this manner to diminish or, in fact, to completely remove the contact or bearing force at the intermediate point of application. Therefore, this bearing force can be accommodated to the working conditions of the machine.

If now the arching jack cylinder 34 is again relieved of pressure by connecting the conduit 38 with the return-flow line, and if the conduit 12 of the track-lifting jack shown in FIGURE 1 is connected with an oil pump, air compressor, or any other source of pressurized fluid medium, then the piston 7 pulls the hook 17 upwards and the latter exerts a certain lifting force at location L. This is transmitted or reproduced on the axles in proportion to the lever arms formed by the frames, whereby the intermediate bearing points B and C, already loaded by the dead-weights, are still further loaded.

Now by operating the arching-lifting jack it is possible to regulate the bearing or pressure force at C in accordance with the work required of the machine.

If now the above two mentioned jacks are again rendered ineffectual and if the second lifting jack is brought

into operation then it will be recognized that on account of the eccentricity of the socket or ball joint 31 in relation to the string of rails 1a, the tractive force exerted on the frame 2 tends to make it pivot, whereby such pulls with it the bogie which is fastened to it by the Cardan support. The bearing force or pressure at C upon the rail string 1 is thus reduced and can even be removed in the event of insufficient dead-weight or in the event of actual tilting.

The lowermost limit of security is reached when the arching jack operates so as to completely remove the load on the axle at location C. In practise there is little reason for anxiety, especially since the two lifting jacks, as a general rule, are conjointly used.

Now if it is desired to reduce the loading at the intermediate bearing point B, instead of at C, it is only necessary to pressurize the chamber 48 by means of a non-illustrated control or regulating device and specifically with any suitable fluid medium to the extent desired. The piston 47 subjected to the pressure load more or less takes the weight off the ball and socket joint and thereby also off the pressure point B. With sufficiently high pressure the bogie is lifted by the ball joint, thereby completely removing the pressure force at B. With this arching by means of the ball joint there appear the same characteristic properties previously described in conjunction with the Cardan system. It should be noted that since the axis 47 is in the section containing the bearing point A, the arching is marginal. It is further to be mentioned that the axle 22 cannot be lifted any further than the plate 20 abutting against the frame 2 allows.

The hydraulic circuit diagram depicted in FIGURE 3 and in the illustrated position clearly shows that the oil pumped by the pump 52 communicates via the rotating piston or valve 60 with the chamber 37 in order to provide the desired pressure and to exert a pull on the cable 41, conveniently omitted from this figure. As already mentioned, the pressure regulator 56 maintains the pressure in the conduit 55 constant, excess oil flowing off by means of the conduit 58. The pressure can be easily regulated by means of the manually operated handwheel 57. Upon rotating the piston or valve 60 by means of the handle 61 one-quarter turn clockwise, the conduits 38 and 55 are connected with the return-flow line 62 and all pressure is released.

It will also be recognized that in the hydraulic circuit diagram of FIGURE 3 there is further shown in phantom lines another arching jack identical with the foregoing one and mounted in parallel with it. In order to make both of them ineffectual at the same time, the rotary piston 60 must be rotated one-half turn.

These two jacks can be used in non-illustrated variants in order to obtain identical arching devices at the ends of the frame 2, which for reasons of construction can also be arranged in juxtaposition or side by side relation.

Under certain circumstances it can be advantageous to arch each of the longitudinal side members of frame 2 directly against one or both bogies by using well-known mechanical coupling techniques, such as the elasticity of springs, rubber and so forth, and even through the use of the elastic deformability of the aforementioned side members of the frame 2. In the same manner the extension or shortening of a jack can be effected obliquely between two or more chassis or frames, or via levers, rods, springs and so forth. In any event, the basic idea of the invention is to create arching by means of at least one jack adjustable during operation in order to reduce the bearing force at the intermediate bearing locations.

In the embodiment of apparatus depicted in FIGURE 4, the two rail strings 1 and 1a are seen as viewed from above and upon which travels the machine which is likewise of symmetrical construction. Here such machine embodies a main frame unit 63 in the form of a horizontal frame formed of welded together sheet steel or steel

plate. Beneath the longitudinal side members 63a there are secured the axle boxes 64 and 64a, 65 and 65a, of the two carrying axles 66 and 67 respectively. The fore-slung portion 63b of the frame unit 63 extending over the axle 67 supports a slewing device of known construction provided with a hydraulic jack, the cylinder 68 of which is fixed beneath the side members 63a of the frame unit 63 and extends transversely thereof. A piston rod 69 pierces into the cylinder 68 and at the center of this rod there is fixed a piston 70 which forms the chambers 71 and 71a within the cylinder compartment. There will also be recognized the conduits or lines 72 and 72a communicating with the chambers 71 and 71a respectively. The two ends of the piston rod 69 form a respective thrust block for two wheels 73 and 73a provided with flanges 74 and 74a respectively. The aforesaid wheels 73, 73a do not rest upon the rails, rather are slightly spaced therefrom, so that one or the other of the flanges 74, 74a can bear against the head of the rail when the assembly 69, 70, 73, 73a, 74, 74a forming the slewing axle slides in the cylinder housing 68.

Apart from this aforescribed structure, the machine further includes a second chassis or frame unit in the form of a T placed horizontally at the same level as the frame unit 63. This second frame unit of T-form is composed of two tubes or pipes 75 and 76 which are welded together. Its central carrier tube or pipe 75 terminates at a ball joint 77 housed in a cage or socket 78 fixed at the center of a front cross member 63c of the first frame unit 63 at the side of the track slewing equipment. At each end of the transverse arm or pipe 76 of the T-frame 75, 76 there is welded a vertical plate 79 and 79a respectively, which carry the non-illustrated axle boxes for an axle 80. The latter passes beneath the arm or pipe 76 and bears upon the rails 1 and 1a as shown.

In the plane of the two frames 75, 76 and 63 there is located a special arching device provided with two jacks. They are of identical construction and each one is composed of a cylinder housing 81 and 81a respectively, slidably carrying a piston 82 and 82a respectively. A respective piston rod 83 and 83a is connected with the associated piston 82 and 82a. The chambers 84 and 84a having the larger cross-sectional area can be fed with a suitable fluid medium by means of the pipes or conduits 85 and 85a respectively, whereas the other chambers 86 and 86a are furnished with such medium by means of the conduits 87 and 87a respectively.

The floor or base of each cylinder 81 and 81a has a fork-like or bifurcated construction, wherein only the uppermost fork arm 88 and 88a respectively, is visible in the drawing. Each of the fork arms 88 and 88a of these bifurcated base portions is pierced by a vertical shaft 89 and 89a respectively, such shafts each also passing through a respective plate member 90 and 90a. These plates 90 and 90a are welded to the crosspiece 63c of the frame unit 63.

At the free end of each of the piston rods 83 and 83a there is fixed a stirrup member 91 and 91a respectively, through which pierces a respective vertical shaft 92 and 92a. The latter are secured to the associated arms 93 and 93a respectively. Each of these arms 93 and 93a is connected for pivotable movement via the shaft 92 and 92a with the stirrups 91 and 91a respectively, and is also welded to the side of the central tube 75, as shown. In the illustrated embodiment, both of the arching jacks just considered are arranged parallel and equidistantly from the central tube 75. It will be appreciated that with the view of preserving the clarity in illustration only enough of the physical structure has been shown which is necessary for the understanding of the invention.

The mode of operation of the machine just considered is as follows: When travelling in either direction, all of the previously mentioned conduits or pipes are freely connected with the return-flow line for the tank and the two frame units 63 and 75, 76 can freely pivot relative

to one another in order to follow the line of the track since they are guided by the usual flanges of the three carrying axles 66, 67 and 80. Moreover, the four previously described pivot arrangements are designed to have sufficient play to allow for slight twisting of these frames caused by the profile of each string of rails 1, 1a. The slewing axle 69, 70, 73, 73a, 74, 74a is constantly guided by the flanges 74 and 74a of its wheels 73 and 73a which, as mentioned, do not touch the top surface of the rails. The dead-weights ensure for the necessary loading on the carrying axles 66, 67 and 80.

In the illustrated position representing the machine at standstill or at a position corresponding to its working speed, the pressure of the fluid medium acting in chamber 71 thrusts the flange 74a of the slewing axle against the rail string 1a at a point of contact R, the hydraulic flow in pipe 72a being freely connected to the tank. The frame or chassis 63 which, owing to the reaction to the pressure exerted upon the rail string 1a is displaced out of true with the track in the direction opposite to the thrust on rail string 1a, bears by means of its axle 66 at location B and by means of its axle 67 at location C against the rail string 1. It is, in fact, prevented from pivoting because of the arching movement of the T-shaped frame or chassis 75, 76, the axle 80 of which bears at the point A against the same rail string 1.

This arching movement can be obtained in a number of different ways: It is possible to have a certain pressure of the fluid medium act in the chamber 86 of only one of the arching jacks which then exerts traction upon the T-shaped frame 75, 76, such traction being balanced by the compression exerted on the ball joint 77 and 78. The fluid in the conduits 85, 85a and 87a is still maintained in free flow with the tank.

Instead of operating this arching jack, it is also possible to place the other one into operation by applying the required pressure through conduit 85a into the chamber 84a. The thus produced thrust is also balanced by the tractive force borne by the ball joint.

It is also possible to operate both arching jacks conjointly, whereby each of them can either work with pulling or compression as in both of the previously explained examples. The resultant of their forces is once again balanced by the ball joint. This can be an interesting advantage from the standpoint of design and the symmetrical construction of the machine is also conserved, so that the jacks can be designed to be less powerful.

Whatever method is employed, it will be seen that—analogue to that which has been described in detail for the vertical lifting forces or the dead-weights—the arching obtained here between both of the frame units 63 and 75, 76, again brings about a reduction in the load on the intermediate bearing point C but in this case in the horizontal plane, the slewing force here playing the part previously assumed by the lifting force. The same thing happens if the string of rails 1a is higher than 1, the dead-weights cause the axles to bear upon the string 1a.

This relationship or similarity in function gives rise to analogous remarks. In particular, it is possible to make use of the hydraulic circuit, shown in full lines in FIGURE 3, to operate a traction jack. The slewing force (or the component of the dead-weight parallel to the track surface) can also act in the opposite direction to that previously assumed, in which case then the machine bears against the string of rails 1a.

In order to arch in one or the other direction, it is possible for instance to provide a single jack which, depending upon the circumstances, works in traction or compression under a constant but adjustable pressure; or alternatively, two arching jacks working on traction and each having its own pressure circuit according to FIGURE 3 can be provided.

Apart from the foregoing, it will be recognized that in FIGURE 5 there is depicted a hydraulic circuit which,

by means of a single and systematically operating control enables the slewing jack and the two arching jacks of FIGURE 4 to be simultaneously operated in either direction in order to obtain a reduction in the force of contact on the corresponding intermediate bearing point. In addition, this reduction is automatically adjusted to the slewing force which is applied, as will be explained in greater detail hereinafter.

It should be appreciated that for convenience in the illustration and description, in FIGURE 5 the same reference characters have been used for analogous elements of the hydraulic circuit of FIGURE 3 and for the components of the aforescribed three jacks of FIGURE 4.

The mode of operation of the hydraulic circuit of FIGURE 5 is as follows: In the depicted neutral position of the system, the pump 52 delivers the entire quantity of oil without pressure by the conduit 55 which is connected to the body 94 of a suitable distributor 95 allowing it to escape by means of the return line 96 back into the container or tank 53. Moreover, the conduits or pipes 72, 85a and 87 are continuously connected to a collector pipe or conduit 97 which itself is joined to the body or housing 94 and communicates via the distributor or slide valve 95 with the return-flow line 96. In analogous manner, the conduits 72a, 85 and 87a are connected with the collector pipe 98 which is once again coupled to the housing 94 and connected via the slide valve 95 with the return-flow line 96. It should thus be apparent that the three jacks are ineffectual or freed—for example when the machine is travelling—and the pump 52 idles.

Now, if the operator displaces the slide valve 95 by means of the handle 99 in the direction of the rail string 1a, in other words upwards in the drawing, until reaching the appropriate stop, the pump 52 maintains the pressure adjusted by the handwheel 57 in the network of conduits 55, 97, 72, 85a and 87, with such conduits now being disconnected from the other conduits or pipes by means of the distributor or slide valve 95. These other or remaining conduits are coupled by means of the distributor 95 with the return-flow line 96 leading to the tank 53. The piston 70 of the slewing jack displaces the piston rod 69 in that direction in which the slide valve 95 has been displaced, in other words, in the direction towards the rail string 1a. It will also be appreciated that the piston rod 83 is pulled and the rod 83a is pushed. Hence, both of the arching jacks 81, 81a relieve the pressure at C, as such corresponds to the situation depicted in FIGURE 4.

It will also be recognized that with the hydraulic circuit of FIGURE 5, if, by using the handwheel 57, another pressure valve is set for the slewing force, there is also simultaneously altered the bearing pressure.

By a careful choice of dimensions (cross-sectional areas or sections, lever arms, etc.) and by taking into account the components of the dead-weight parallel to the track surface, the forces resulting from other working tools, and so forth, it is possible to determine or control the upper or maximum value of the bearing force on the intermediate bearing point, or also its lower or minimum value in order to prevent for example the lifting of the axle at this point.

By pushing down the operating handle 99 in the other terminal position, the slewing and bearing forces are at the same time reversed owing to the action of the distributor or slide valve 95 which then interchanges the connections to the jacks, as should be obvious from an inspection of this figure.

In the preferred embodiment of machine depicted in FIGURES 6 and 7, there will be recognized the string of rails 1, 1a of the track upon which stands a tamping machine 100 of conventional construction with foreslung tools, conveniently designated by reference character 101. The tools 101 for tamping, operating by vibration and mutual closing or advancing movement, are mounted together with their drive mechanism 102 upon the frame

unit 103 of the tamper 100 in front of the carrying axles 104 and 105. Further in front there will be seen a caisson or member 106 welded to one end of the frame unit 103 and which encloses mechanism of standard construction known to the art for lifting and slewing the track by means of hooks, such as those designated by 107.

Forwardly of the tamper 100 there is located a second frame unit or chassis, here shown composed of three pipes or tubes 108, 113, 117 which are assembled to form the edges of a trihedral. The lower pipe or tube element 108, which in this case is horizontally arranged by way of example, is extended in axial direction by a cylinder 109 of a hydraulic jack, the piston rod 110 of which is pivoted on the vertical pivot pin 111 of a bifurcated member or fork 112. The latter, in turn, is welded centrally at the frontal face of the caisson 106. The two other pipe members 113, 117 collectively form a V which is symmetrical with respect to the central plane of the track and the machine. In FIGURE 6 there is only visible the forwardmost pipe member 113, although both such pipe members can be clearly seen in FIGURE 7. Continuing, it will be recognized that at the apex of this trihedral, formed of the pipes 108, 113, 117, there is mounted the carrying axle 114 for supporting such trihedral at its head or apex end. At the opposite end a pivot pin 115 is welded to the frame unit 103 perpendicular to the plane of the aforesaid V formed by the members 113, 117. The aforementioned axle 114 can rotate in a pipe 116 centrally of which there are welded the tubes 108, 113, 117. The diverging end of both tubes or pipes 113 and 117 are interconnected by means of a lever system situated in the plane of the V and to be considered in detail shortly.

In this regard, and by referring more specifically to FIGURE 7, it will be seen that a deformable parallelogram is formed by a steel plate 118 connected at its ends 119 and 120 to two levers 121 and 122 respectively. Levers 121 and 122 are, in turn, pivotably mounted to the foreslung portion of the frame 103 by means of the vertical pivot pins 123 and 124 respectively, and to each side of this frame and rearwardly of the plate 118. An intermediate web or crosspiece 125 welded to the frame unit 103 transversely of the central plane ensures for a constant spacing between the pivot pins 123 and 124.

The levers 121 and 122 each possess a respective arm which is outwardly directed away from the machine 100 as shown, and which are constructed to clamp the spherical articulating head 126 and 127 respectively, of the tubes 113 and 117 respectively, to thereby thus form a ball joint connection. Both of the lever arms of the levers 121 and 122 are of the same length. It will also be seen that the lever 122 has a third arm 122a extending opposite to the first arm articulated with the plate 118. To this arm 122a there is mounted a pivot pin 128 on which pivots the piston rod 129 of a hydraulic jack. This jack is arranged transversely upon the frame 103 and its cylinder 130, in turn, is pivotally mounted on the previously considered pivot pin 115, as clearly shown in FIGURE 7.

In this figure there is shown an axial section of the jack cylinder 130 wherein the cylinder chamber 130a at the side of the piston rod 129 is supplied by the conduit 131 and the other chamber 130b by the conduit 132. Analogously, for the cylinder 109 there is provided a conduit 133 feeding the chamber 109a at the side of the piston rod 110 and a conduit 134 for the other chamber 109b. To preserve the clarity in illustration, the details of the hydraulic circuit have here been omitted, but it will be self-evident from the previous description how such jacks can be supplied with pressurized fluid medium.

With the foregoing explanation in mind, the mode of operation of the embodiment of FIGURES 6 and 7 is as follows: In the illustrated position, the four conduits 131, 132, 133 and 134 are connected for free flow to the tank for the oil or otherwise and both of the jacks are there-

fore ineffectual. If the profile of the track is concave or convex, for instance by descending or ascending gradient, the axial jack 109, 110 correspondingly shortens or lengthens, whereby the V formed by the members 113, 117 pivots about the articulating heads or joints 126 and 127 respectively, which remain fixed. Additionally, if the machine is located in a curve, then the aforescribed parallelogram will be deformed due to the rotation imparted to the V members 113, 117 by the axle 114. It should be noted that this mechanism not only alters the length of the two jacks, but also causes the tubes 113 and 117 to bend slightly, which is without any practical disadvantage when considering their great length and the minimum radius curves permitted on railroad tracks. Moreover, it is possible to replace the aforementioned parallelogram arrangement by a single lever.

Further, the small amounts of twist of the tracks can also be absorbed by deformation (elastics) without practical significance. If necessary, it would also be possible to provide an axial pivot pin at the head end of pipe or tube 108 in order to make the axle 114 pivotable.

Now, if the axially extending jack is pressurized by the conduit 133, the tube 108 is pulled and the tubes or pipes 113 and 117 are compressed. Consequently, the plate or rod 118 is pulled via the levers 121 and 122 which prevents the latter from pivoting. The frame 103 is therefore arched by the trihedral frame 108, 113, 117 and the intermediate axle 104 is relieved of weight to a lesser or greater extent, analogous to what has been described in the first embodiment.

It should here still be mentioned that when travelling the weight of the foreslung portion of the frame can advantageously be balanced by arching with constant pressure on the axis 114, which in this case at the same time is sufficiently loaded in order to permit high speeds.

Above all, it must be emphasized that when the machine is working the arching jack allows the load to be lightened on the axis 104. This axle 104 is located in the most unfavorable position and subjected to the most adverse conditions since it must support the overload and the lifting force of the foreslung part whilst at the same time it is close to the tools 101 which vibrate the ballast.

It is further mentioned that for the off-tracking or on-tracking of the machine, the same jack 109 working in the opposite direction can lift the axle 114, whereby the other jack is then blocked. This facilitates lateral displacement of the whole machine.

If a slewing force is to be applied against the rail string 1a, that is, directed towards the top of FIGURE 7, then the transverse arranged jack 130 is pressurized by means of the conduit 132. Whereas such jack then bears against the pivot pin 115, such action causes it to outwardly displace the pivot pin 128 by means of its piston rod 129. Both of the levers 121 and 122 which are interconnected by the plate 118 are then forced to rotate in the same direction, i.e. counterclockwise in the drawing of FIGURE 7. Hence, the tube or pipe 117 is compressed and the tube 113 subjected to tension, thus pushing the axle 114 against the string of rails 1. Consequently, and due to the cooperation of the pivot pins 115, 123 and 124, all affixed to the frame 103, arching of the latter on the trihedral frame 108, 113, 117 is brought about and there is obtained an easing of the flange of the axle 104 applied against the string of rails 1, analogous to the second embodiment hereindescribed.

The principle of operation is therefore the same, notwithstanding the inclined arrangement of the tubes 113 and 117. It is also a requirement that the dead-weight is sufficiently large to prevent a tilting of the frame.

The combination of two arching movements in vertical and horizontal direction, under the simultaneous action of the corresponding jacks can be carried out in the simplest manner by superimposing the forces and does not present any great difficulty. This can be easily ascertained by examining for example one of the various

possible embodiments, for instance by assuming that in FIGURE 4 both of the frames are to be arched in the vertical plane by means of a jack arranged obliquely to the plane of symmetry which is connected at one end to the central carrier pipe 75 and at the other end articulated to a carrier welded to the upper portion of the frame 63.

It is further indicated that the trihedral formed of the members 108, 113 and 117 in the embodiment of FIGURES 6 and 7 could be inverted, in other words, the pipe 108 extending at an inclination upwardly and the two V-shaped pipes 113 and 117 then extending horizontally symmetrically of the central longitudinal plane. Moreover, with such an arrangement it would be possible to simultaneously employ the arching movements in vertical or horizontal direction for conjointly lifting and slewing the track, thereby saving on the use of separate jacks for lifting and slewing. Furthermore, the teachings of the invention as applied to the embodiment of FIGURES 6 and 7 for instance, are certainly not limited solely to a trihedral type frame, other geometrical frame configurations could obviously be employed.

It is here also remarked that another useful example would be a machine consisting of two vehicles or frame units each provided with two carrying axles which arch frontally against one another by means of a hook and appropriately arranged jacks positioned so as to reduce the forces on the intermediate axles.

The described exemplary embodiments therefore enable overcoming the disadvantages previously enumerated of the known machines with two carrying axles or with frames or chassis simply articulated together. Finally, it is sufficient to briefly enumerate the principal advantages gained by reducing or lightening the intermediate force or forces of contact at the intermediate contact or pressure locations:

(a) Avoidance of sinking of the ballast or the disalignment of the track, mainly due to the vibrating tools, thus making possible large lifts and slews of the track;

(b) Elimination of strong pseudo-elastic deformations, thereby improving the accuracy of levelling and lining the track;

(c) Reduction in the lifting and slewing forces exerted by the rail clamps, thus eliminating excessive stresses in the rails, fastenings and so forth, and also avoiding damage to the rails by the rail clamps, and further enabling reduced weight of the mechanical components and so forth;

(d) Ability to accommodate the machine to various working conditions and traveling conditions; and

(e) Possibility of manufacturing machines of great length, with tools only slightly offset in the curves and with an extensive area of the track left undisturbed.

While there is shown and described present preferred embodiments of the invention it is to be understood that the invention is not limited thereto but may be otherwise variously embodied and practised within the scope of the following claims.

What is claimed is:

1. In the art of railroad trackwork machines employing tool means and at least two frame units articulated to one another which bear at least at three axially spaced locations upon the railroad track, the tool means being supported at a location intermediate the outermost bearing locations, the improved method of operating said trackwork machine which comprises the steps of applying a force to at least one of said articulated frame units to cause said frame units to arch in order to selectively relieve the bearing pressure exerted upon said railroad track at least at the bearing location closest to said tool means.

2. In the art of railroad trackwork machines, the method of operating said trackwork machine according to claim 1, wherein said force applied to said at least one articulated frame unit causes both of said frame units to bear against one another under the application of a rotational movement imparted to each frame unit in opposite directions, to thereby cause said articulated frame

units to arch at least at the region of said bearing location closest to said tool means.

3. In the art of railroad trackwork machines, the method of operating said trackwork machine according to claim 2, wherein said two frame units arch in a substantially vertical plane.

4. In the art of railroad trackwork machines, the method of operating said trackwork machine according to claim 2, wherein said to frame units arch in a substantially horizontal plane.

5. In the art of railroad trackwork machines the method of operating said trackwork machine according to claim 4, wherein arching in said substantially horizontal plane can be selectively carried out to either side thereof.

6. A trackwork machine for railroad tracks comprising at least two frame units, means for articulating said frame units to one another, said frame units bearing upon the railroad track at least at three axially spaced locations, tool means carried by at least one of said frame units at a location intermediate the outermost bearing locations of said frame units upon said railroad track, and means for applying a force to at least one of said frame units to cause said frame units to arch in order to selectively relieve the bearing pressure exerted upon the railroad track at least at the bearing location in the neighborhood of said tool means.

7. A trackwork machine as defined in claim 6, wherein said force-applying means applies a force causing both frame units to rotate towards one another in opposite directions, to thereby arch said frame units in order to relieve the bearing pressure of at least said bearing location in the neighborhood of the tool means.

8. A trackwork machine as defined in claim 6, wherein said force-applying means effectuates arching of said frame units in a substantially vertical plane.

9. A trackwork machine as defined in claim 6, wherein said force-applying means effectuates arching of said frame units in a substantially horizontal plane.

10. A trackwork machine as defined in claim 6, wherein said force-applying means comprises at least one jack mechanism.

11. A trackwork machine as defined in claim 6, wherein said force-applying means includes at least one jack mechanism for bringing about arching of said frame units in a substantially horizontal plane and at least one jack mechanism for arching said frame units in a substantially vertical plane.

12. A trackwork machine as defined in claim 10, further including means for delivering a pressurized fluid medium under constant but adjustable pressure to said jack mechanism.

13. A trackwork machine as defined in claim 10, further including means for delivering a pressurized fluid medium at a variable pressure to said jack mechanism which is dependent upon the forces exerted by said tool means.

14. A trackwork machine as defined in claim 6, wherein at least one of said frame units is a railroad vehicle at one end of which said tool means is mounted in foreslung fashion, the other frame unit being articulated to said one end of said one frame unit carrying the foreslung tool means.

15. A trackwork machine as defined in claim 7, wherein one of said frame units is constructed from at least three members arranged to provide an apex portion at one end located above one of the outermost bearing locations, the ends of said three members opposite said apex portion being connected with the other frame unit, one of the ends of one of said three members being located substantially at the central longitudinal plane of said trackwork machine, whereas the other two members are disposed substantially symmetrically with respect to said central longitudinal plane.

16. A trackwork machine as defined in claim 15, wherein said force-applying means comprises a first longi-

15

tudinally extending jack mechanism for acting upon said one member having said one end located substantially at said central longitudinal plane in order to produce an arching effect upon said frame units in a vertical plane.

17. A trackwork machine as defined in claim 16, wherein said force-applying means further comprises a second transversely extending jack mechanism acting upon said other two members in order to produce an arching effect upon said frame units in a substantially horizontal plane.

18. A trackwork machine as defined in claim 17, wherein said other two members are inclined at an inclination to the horizontal.

19. A trackwork machine as defined in claim 15, wherein said frame unit constructed of at least three members is formed as a trihedral.

20. A trackwork machine for railroad tracks comprising at least two frame units, means for articulating said frame units to one another, said frame units bearing upon the railroad track at least at three axially spaced loca-

16

tions, tool means carried by at least one of said frame units at a location between the outermost bearing locations of said frame units upon said railroad track, and means cooperating with said frame units to apply a force causing said frame units to bear against one another due to each frame unit carrying out a rotational movement opposite the rotational movement of the other frame unit, said frame units thereby arching in order to selectively relieve the bearing pressure exerted upon said railroad track at least at the bearing location closest to said tool means.

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