March 6, 1951 H. MAYER 2,543,794

TRACK SCALE

Filed Nov. 19, 1945 6 Sheets-Sheet 1

Fig. 1.

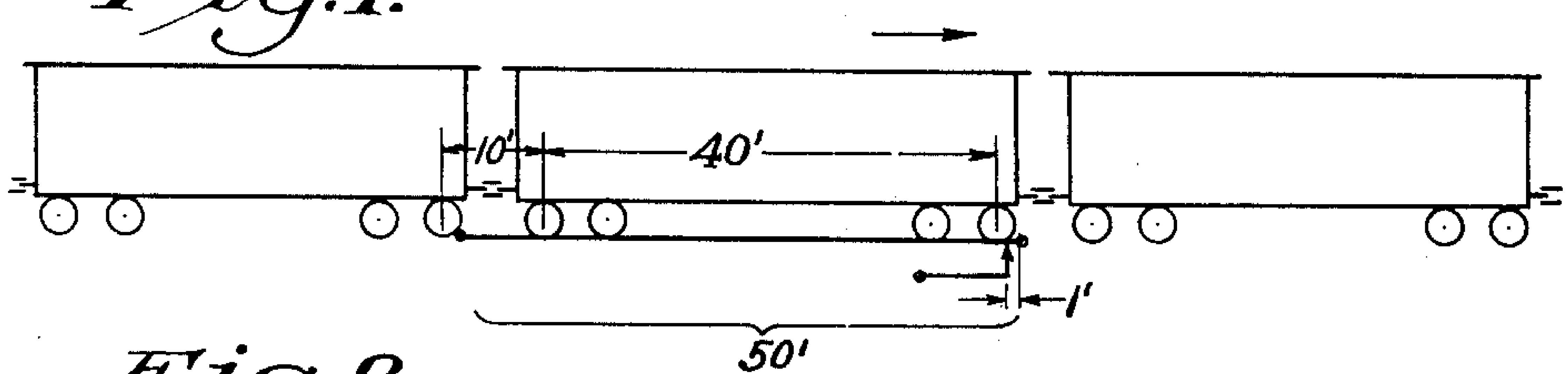


Fig. 2.

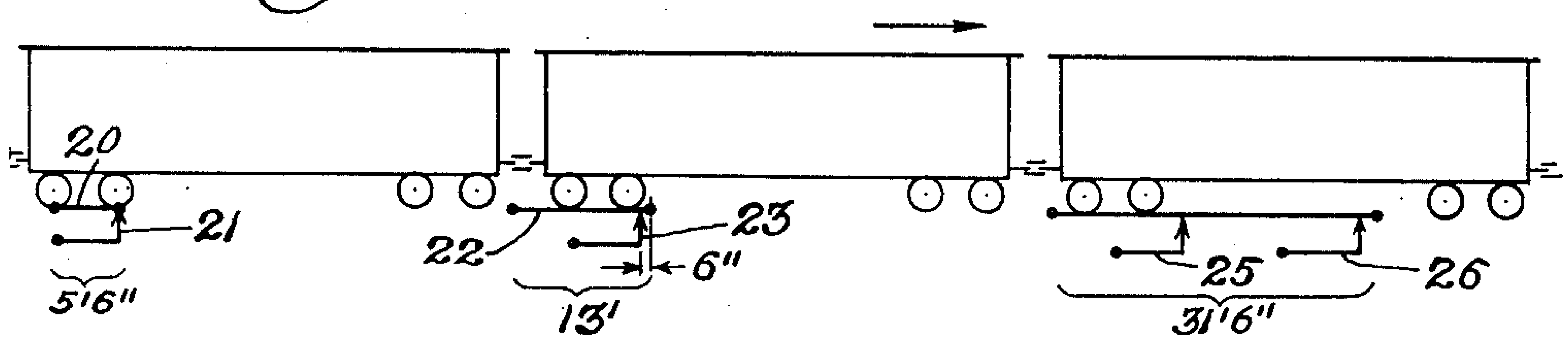


Fig. 3.

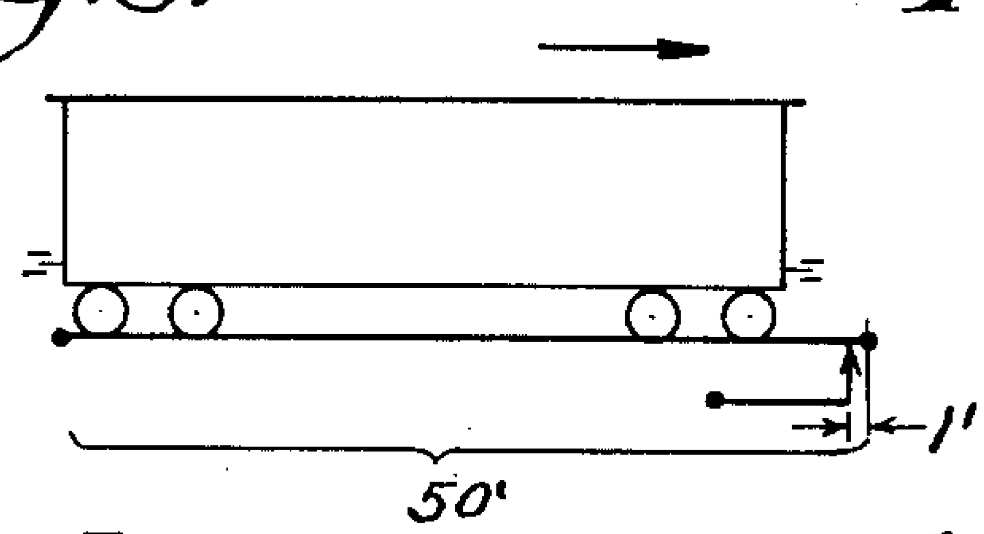


Fig. 4a.

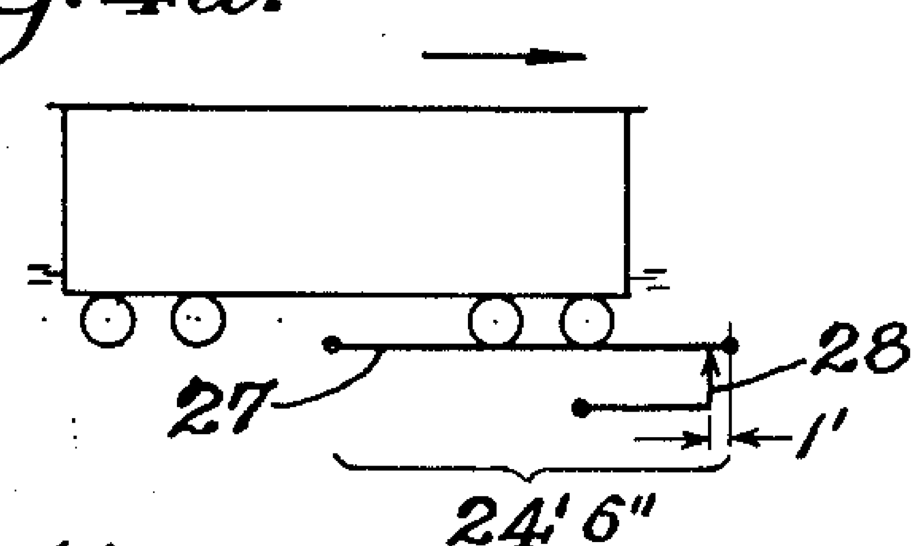


Fig. 5.

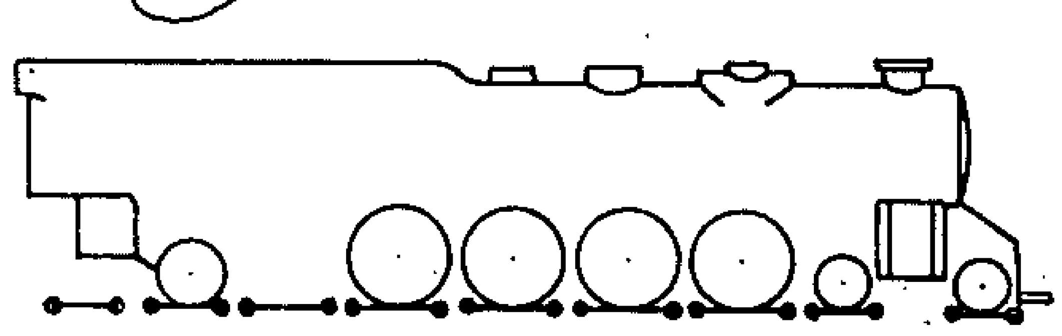


Fig. 4b.

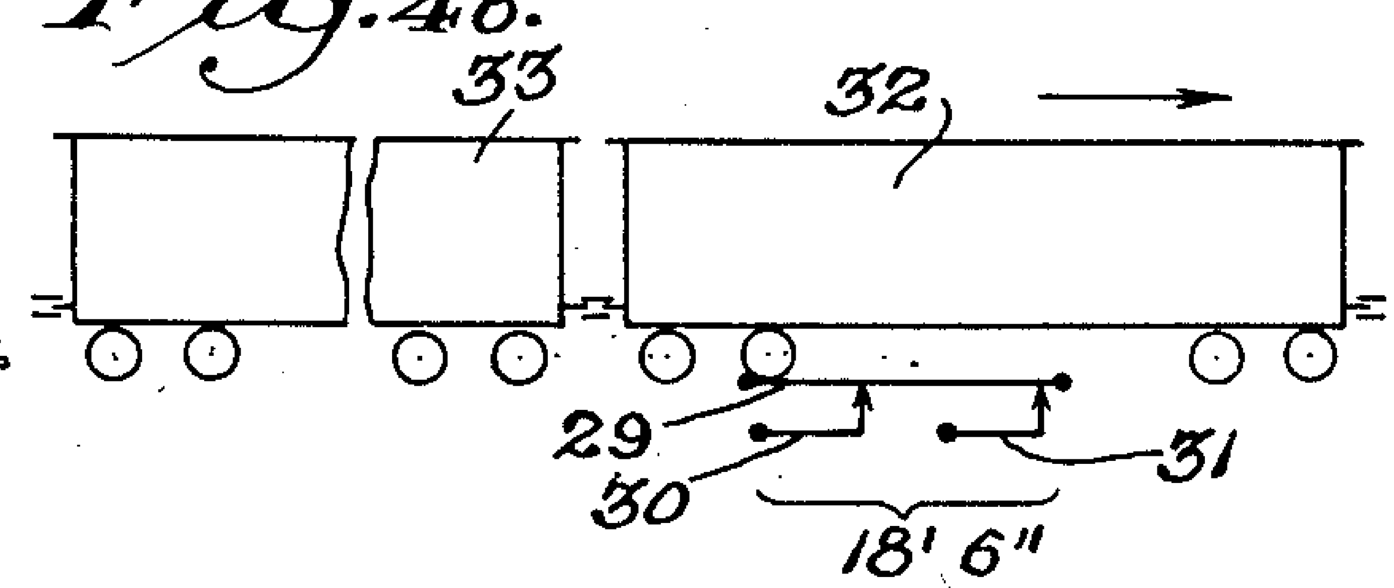
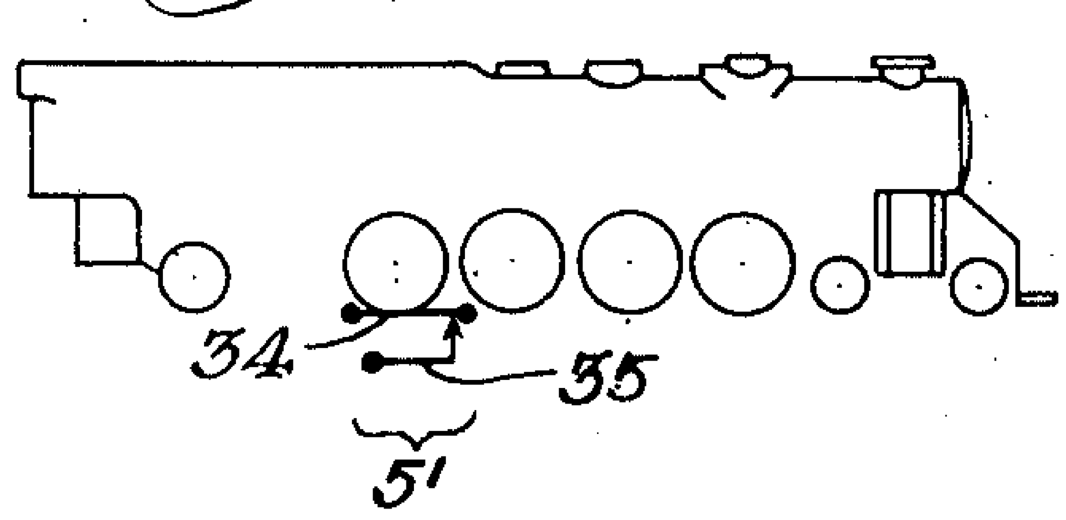


Fig. 6.



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TRACK SCALE

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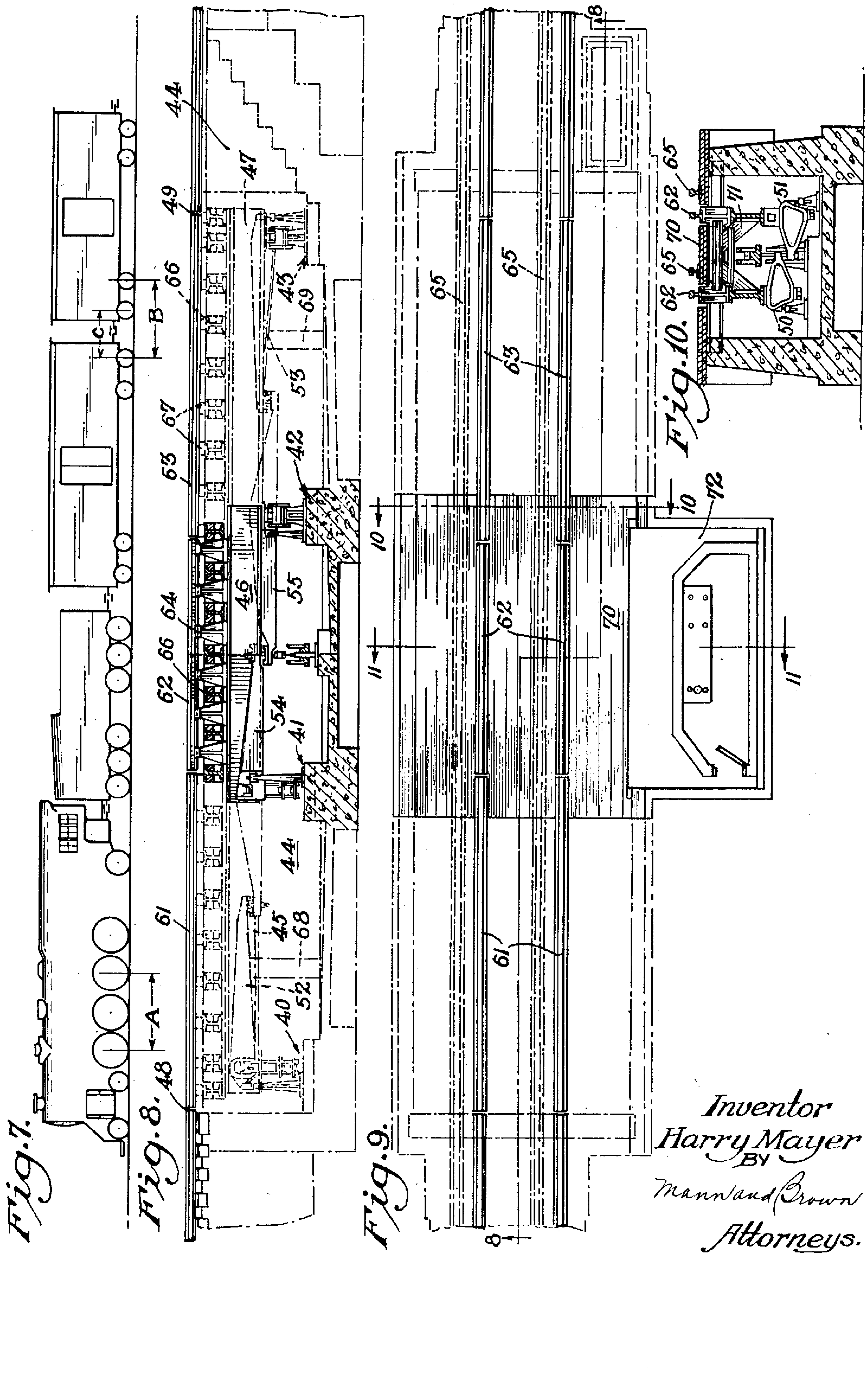

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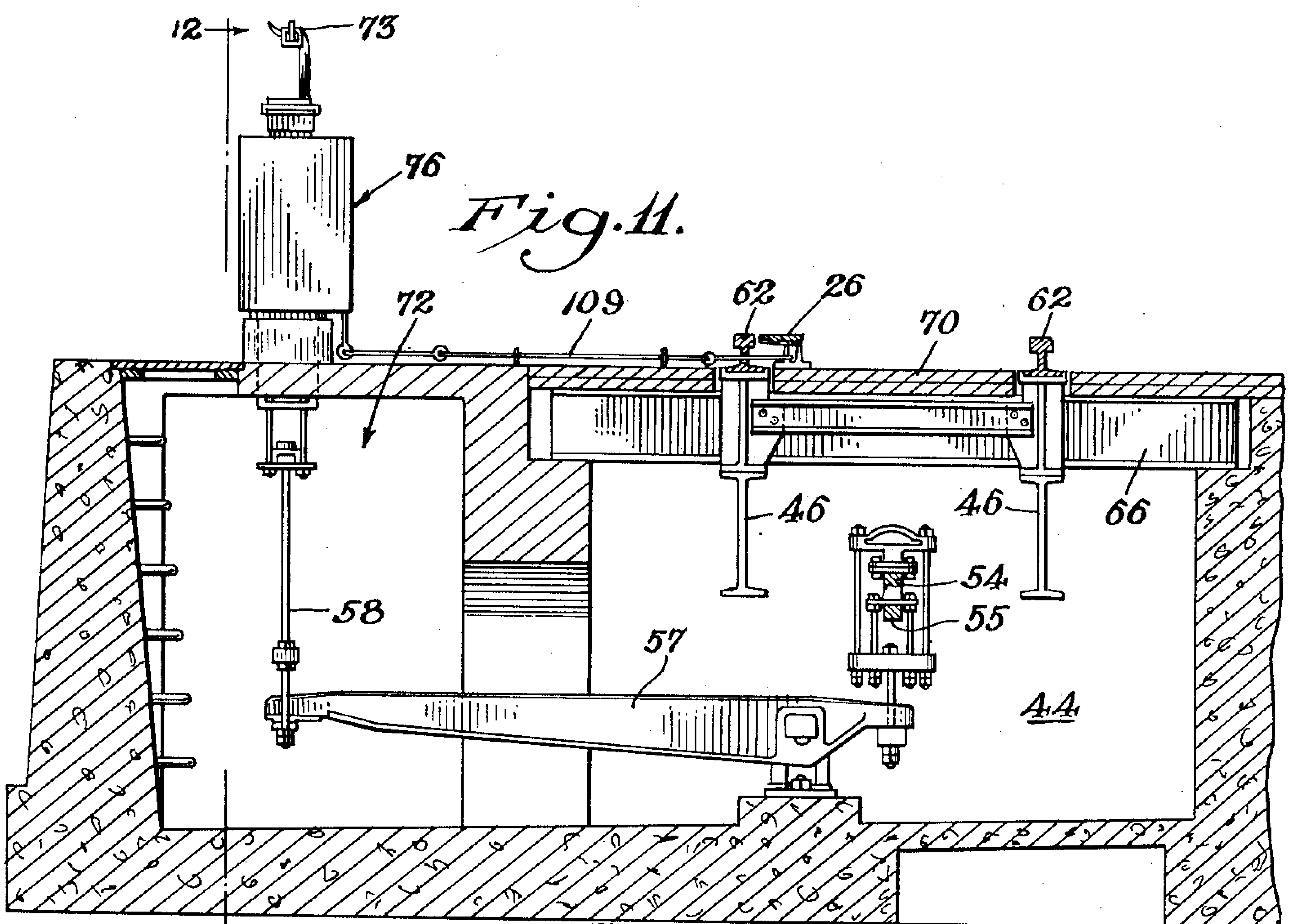

Fig. 11.

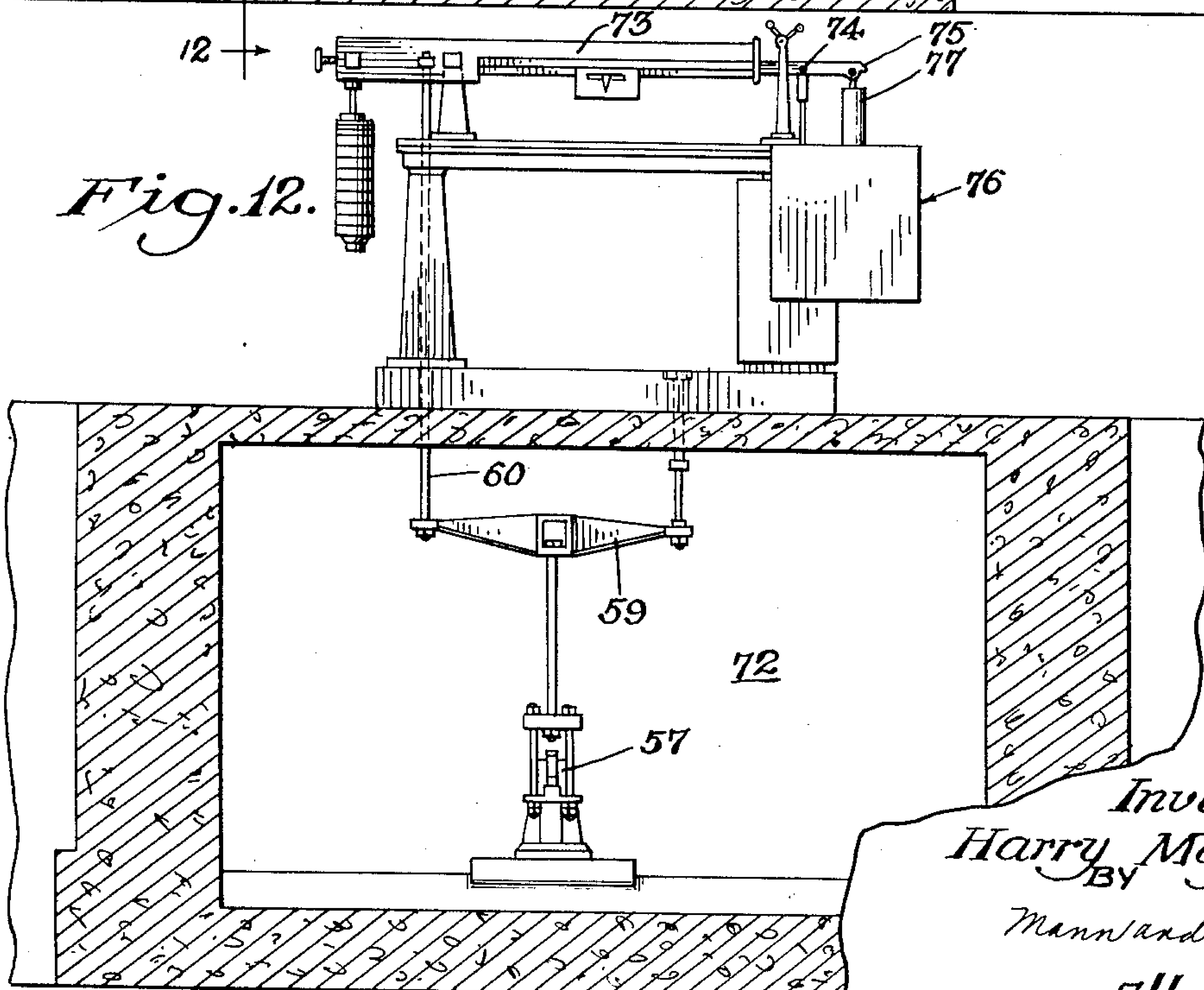

Fig. 12.

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Fig. 13.

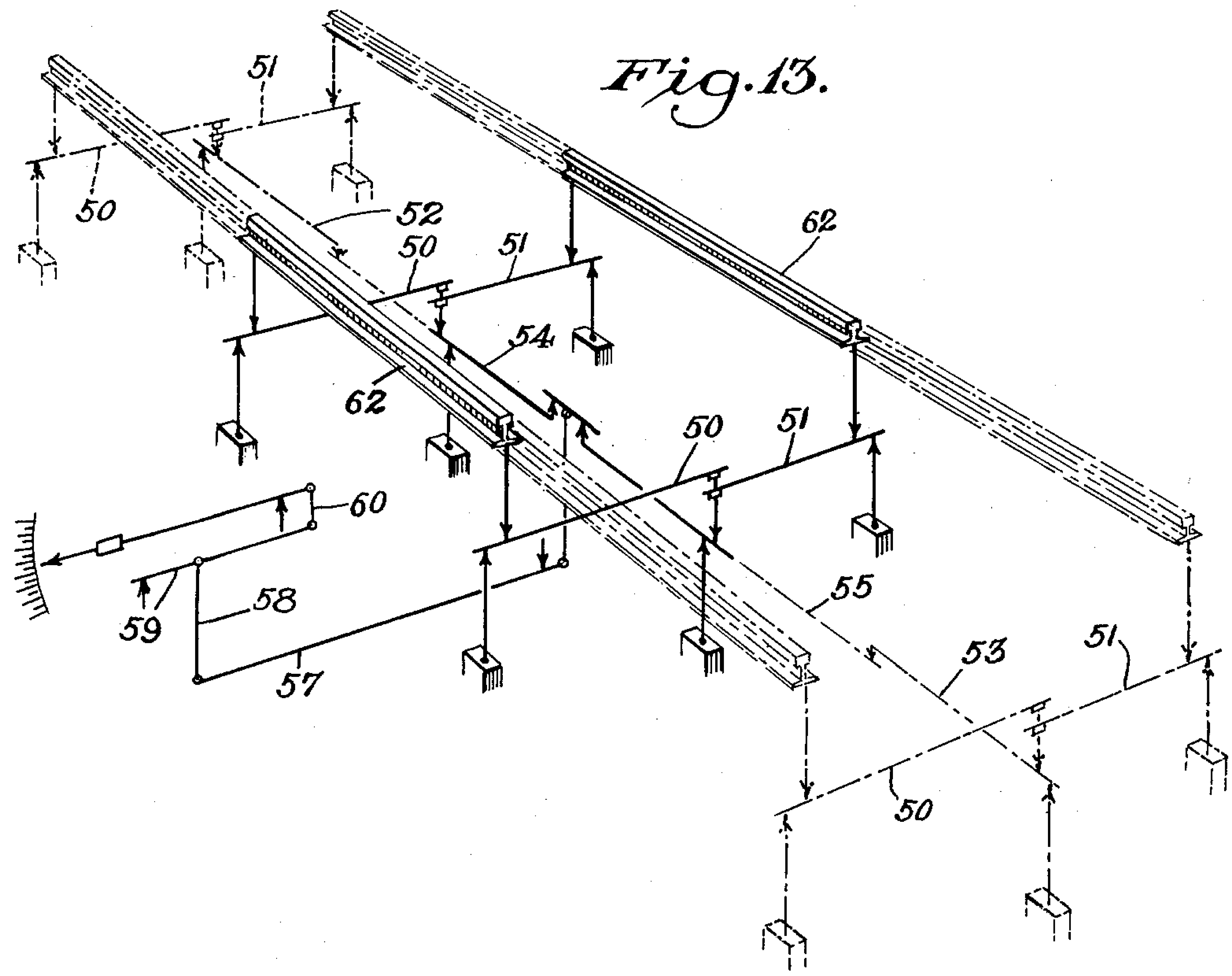

Fig. 14.

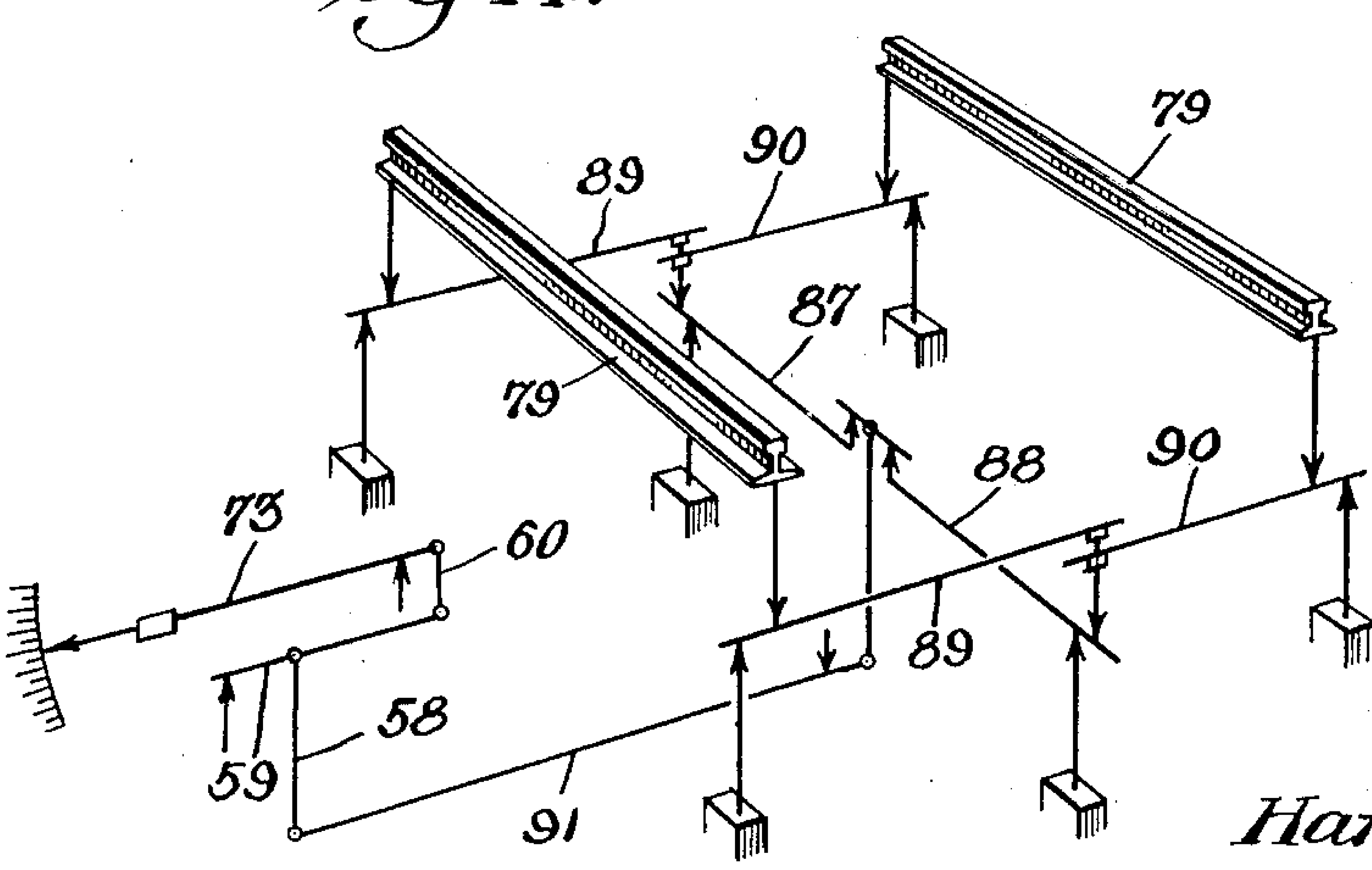

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Fig. 17.

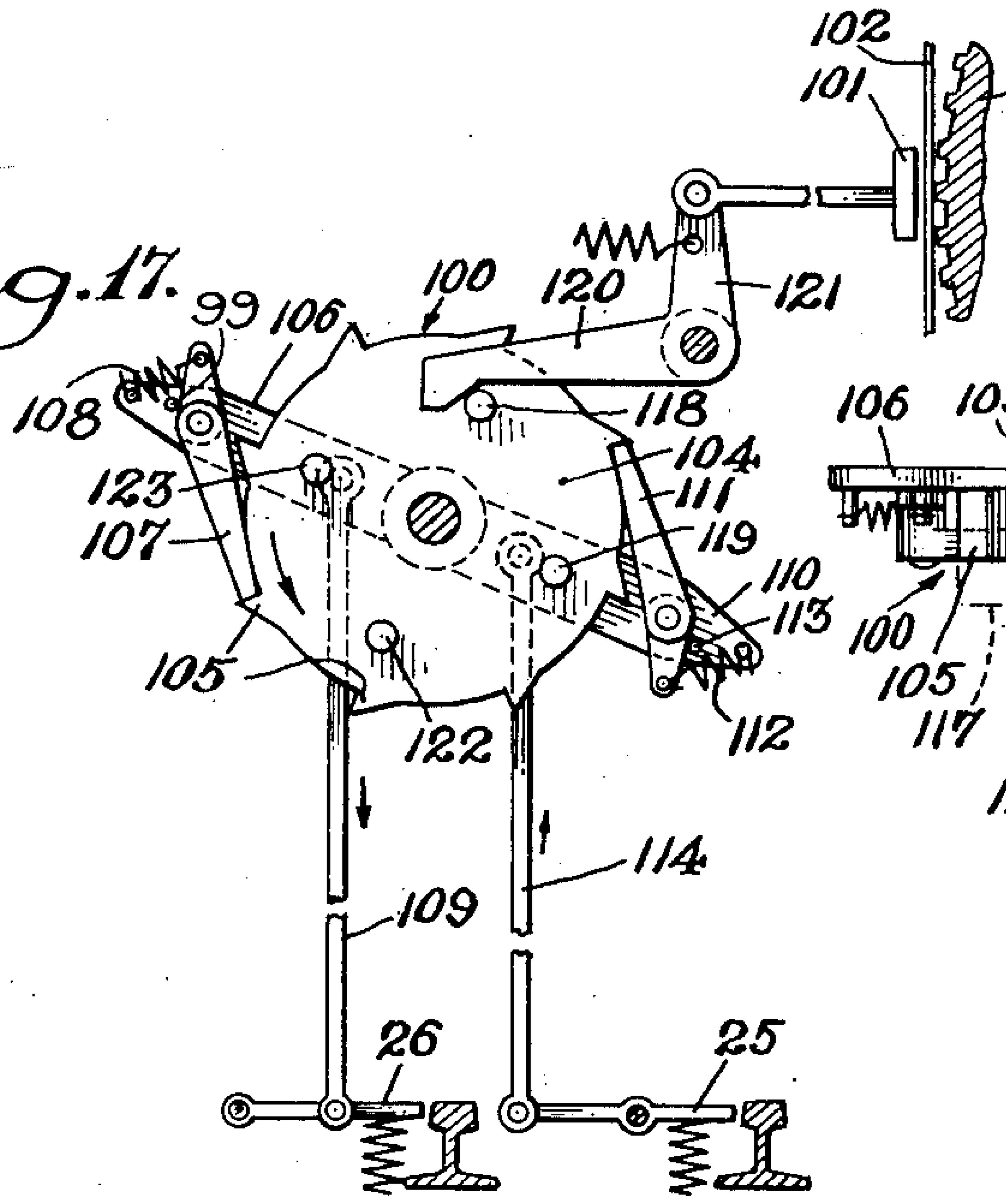


Fig. 18.

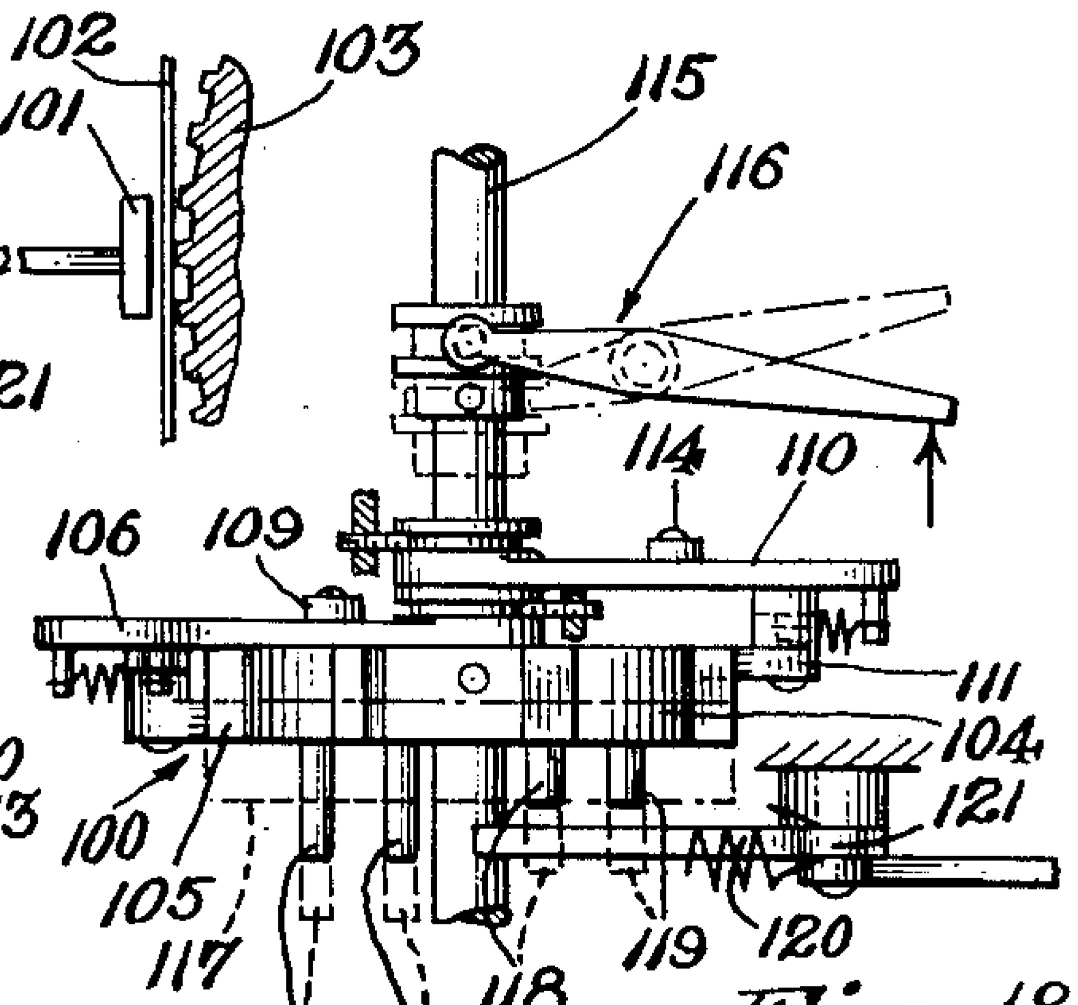
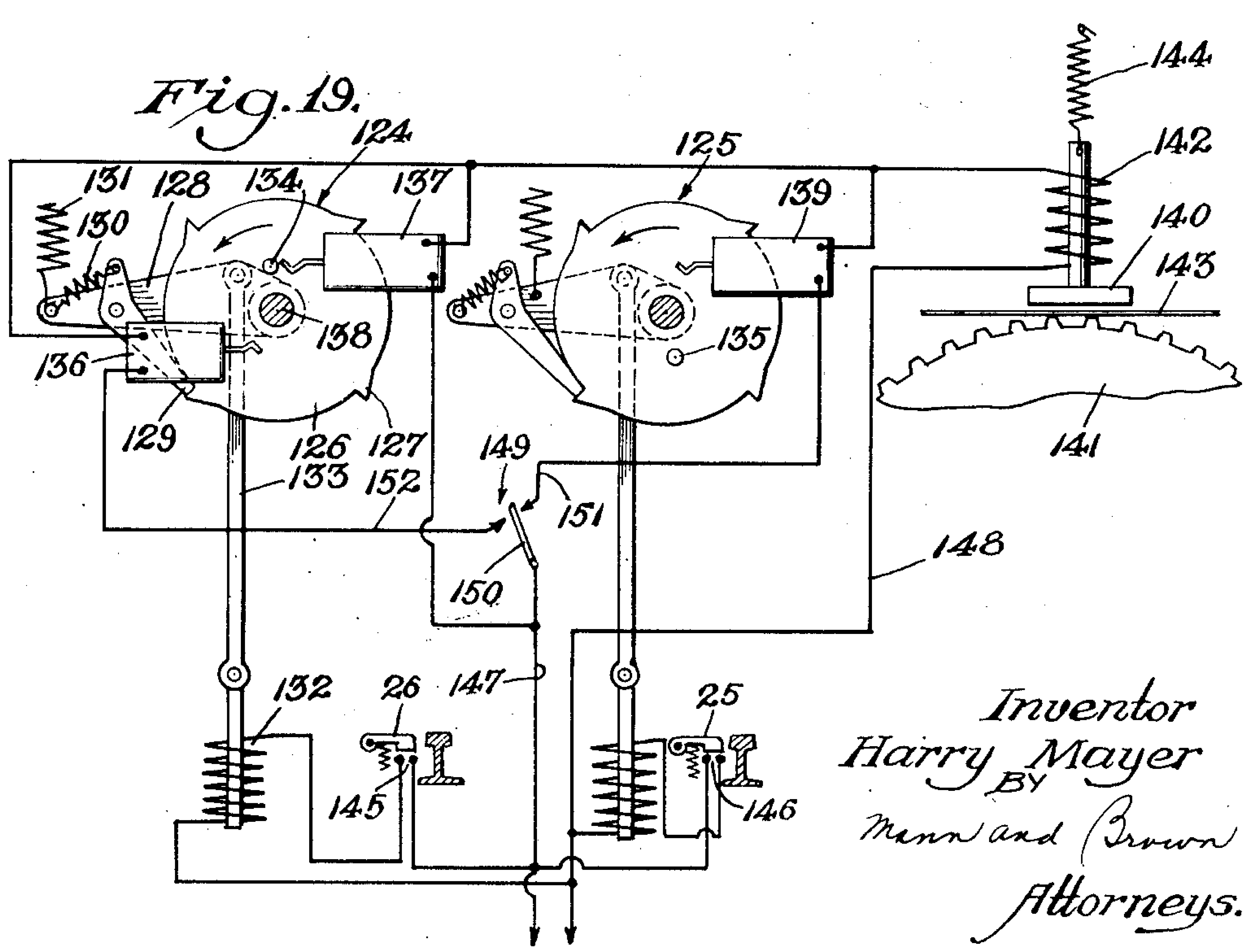


Fig. 19.



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TRACK SCALE

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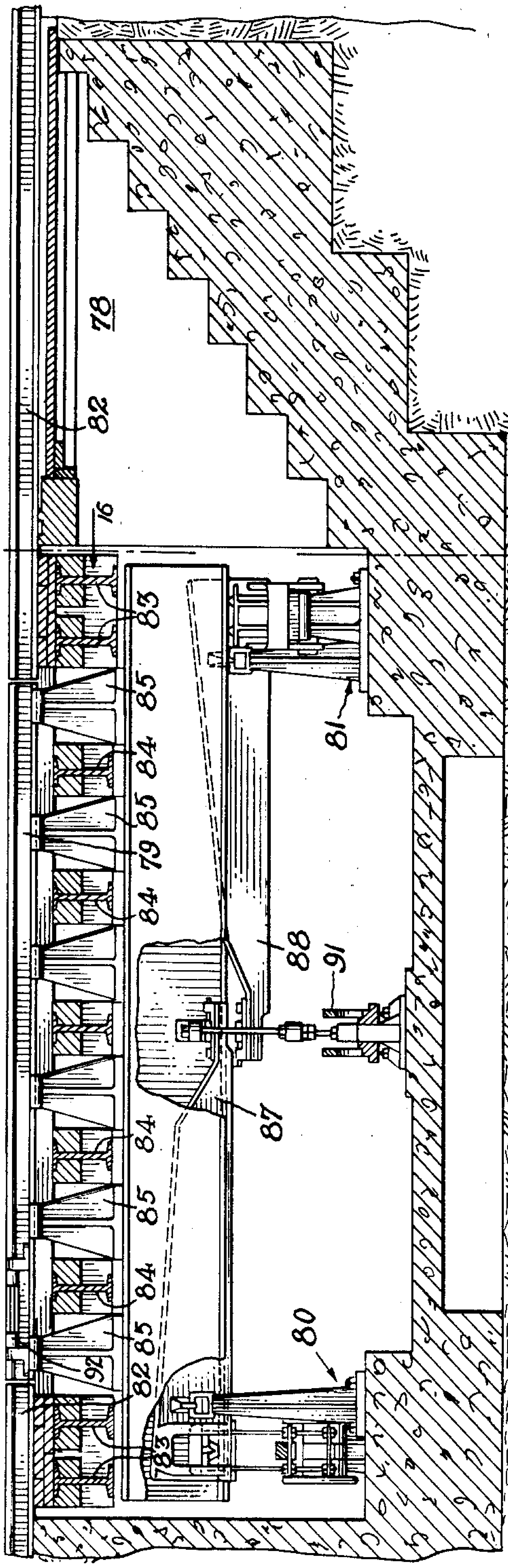

Fig. 15.

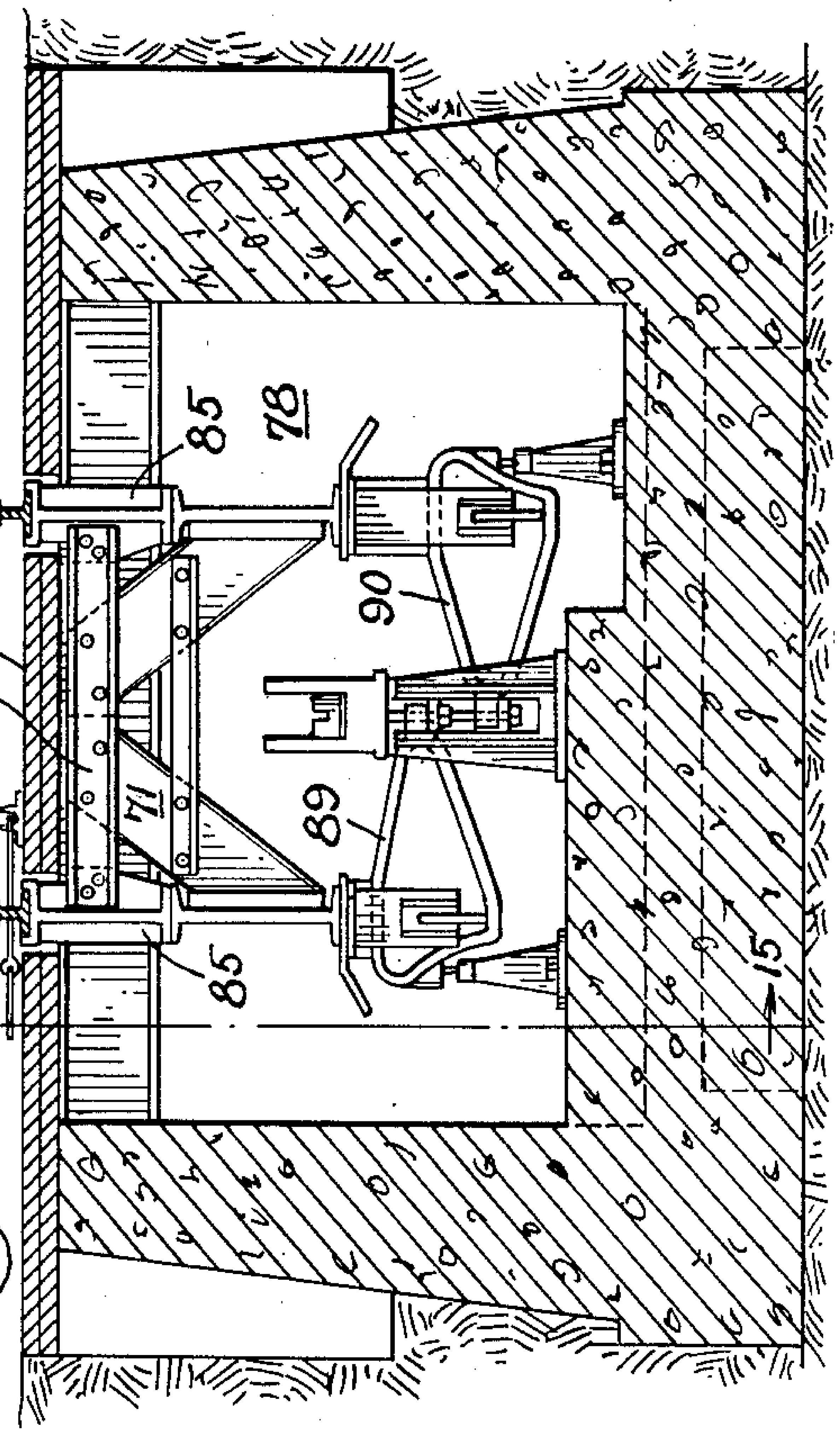

Fig. 16.

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UNITED STATES PATENT OFFICE

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TRACK SCALE

Harry Mayer, Chicago, Ill., assignor to Streeter-Amet Company, a corporation of Illinois

Application November 19, 1945, Serial No. 629,596

12 Claims. (Cl. 265—27)

This invention relates to the weighing of railway rolling stock, particularly freight cars and locomotives, and the principal object of the invention is to provide an improved method and apparatus for this purpose.

The revenue derived from a railroad from its freight traffic is based upon the weight of the goods shipped and, while in some cases weights are determined before the goods are loaded into a car, by far the most common method of determining weights is to weigh the cars after being loaded, and then deducting the weight of the car itself to get the pay load.

The track scales used for weighing freight cars, either loaded or unloaded, are in general of two classes; heavy duty scales which are built sufficiently strong to weigh any type of car that may travel over the scale, and light duty scales which are designed for limited use in weighing cars of specific sizes and maximum weights. Due to the limited capacity of light duty scales, it is customary to provide what is known as a dead rail to enable locomotives and other heavy equipment to pass over the scale without imposing their weight upon the scale mechanism.

The heavy duty scales are, in most cases, sufficiently massive that they will support a locomotive, thereby making use of a dead rail unnecessary.

The weighing of cars is customarily done by either "spot" weighing, "gravity" weighing, or by weighing the cars while in motion and coupled to other cars. In spot weighing, the car to be weighed is brought to a stop on the weigh rail while uncoupled from other cars, and, after its weight has been determined, it is then moved from the scale and another car brought into weighing position. If a car is too long, or its weight is too great for the capacity of the particular scale, two-draft weighing is resorted to, this being accomplished by weighing first one truck and then the other truck of the car and adding the weights to get the total weight of the car. Single draft weighing is, of course, the weighing of both trucks of a single car simultaneously.

In gravity weighing, the track scale is located on an inclined track so that as individual cars are allowed to roll down the track over the scale, the weight is recorded while the car is in motion on the weigh rail.

The weighing of cars in motion while coupled in a train may be done on either heavy duty or light duty scales, but, with the latter type of scale, and with heavy duty scales equipped

with a dead rail, the engine and three or four cars must be run over the dead rail and then the cars only are backed across the scale to be again coupled to the train after which the engine slowly pulls the cars over the scale and the weights are recorded.

Heavy duty track scales, of the knife-edge type, are generally made in two sections with the capacity of each section ranging from 150 to 200 tons, with weigh rails ranging from 50 to 75 feet in length, and with weigh beam capacities ranging from 300,000 to 400,000 pounds. Others of still greater capacity and number of sections are also in regular service. For example, four-section railway track scales are used for heavy duty work and are designed for either spot or motion weighing. Their sizes and capacity, like all track scales, are based upon the traffic weighed rather than the size of individual car loads. Those in regular service vary in sectional capacity from 50 to 75 tons for those intended for light service, while their heavy duty counterparts have sectional capacities ranging from 75 to 200 tons. Lengths of weigh rails in modern scales generally range from 46 to 60 feet for the light service type and from 60 to 70 feet for the more common installations of heavy duty scales, while in some instances the weigh rails are 110 feet in length.

Where the volume of traffic to be weighed is heavy, certain economies are effected by using automatic weight-recording devices associated with the scale beam. The capacities of the recorders range from 70,000 pounds to 400,000 pounds and the graduations are from 50 to 200 pounds. These recorders automatically weigh the cars and print the weight on the weigh tickets while the cars are in motion. The recorders permit weighing by the gravity, coupled in motion, or spot methods. In some of the designs, a timing and counting mechanism controls the weighing operation and prevents the printing of the correct weight until the scale is in balance. Cars can be weighed at an average of two to four per minute, the time depending upon the length of the scale and the type of recorder used.

The foregoing facts are set forth in more detail in the Railway Engineering and Maintenance Cyclopedia, published by Simmons-Boardman Publishing Corporation, Chicago, Illinois, Fifth Edition, 1942, pp. 711 to 720, and reference is made to this publication for additional material pertaining to the state of the art.

The cost of present day track scales may run

$15,000 to $150,000, or even more. In general, it has always been considered necessary to increase the size and capacity of a scale whenever a scale is required for heavier duty service, or for service with cars of longer wheel base than that for which the scale was originally designed.

The amazing and striking fact about the present invention is that existing track scales may be modified to increase their capacity and ability to weigh heavier and longer cars, not by increasing the size of the scale, but by decreasing it. The resultant savings in cost of construction, maintenance and operation is tremendous. Furthermore, scales made in accordance with my invention have greater flexibility and the same scale can be used for weighing rolling stock of varying length, even when the cars are coupled together and in motion.

These and other objects and advantages will become apparent as the disclosure proceeds and the description is read in conjunction with accompanying drawings, in which

Figure 1 and 2 diagrammatically illustrate a comparison between the present method of weighing cars coupled and in motion and my improved method for the same,

Figure, 3, 4*a* and 4*b* compare the old gravity method of weighing uncoupled cars in motion with my improved method and apparatus for the same,

Figures 5 and 6 make a similar comparison between conventional locomotive track scales for the static weighing of locomotives and my improved method and apparatus for weighing them in motion,

Figure 7 shows a freight train with some of the critical distances which affect the size and capacity of the scales that must be used for weighing the individual cars of the train,

Figure 8 is a longitudinal sectional view of a four-section three-span track scale converted in accordance with my invention to a two-section single-span scale, the unused portions of the old scale being shown in dotted lines and the retained or modified portions in full lines,

Figure 9 is a plan view of the converted track scale of Figure 8,

Figure 10 is a cross-sectional view taken on the line **10—10** of Figure 9, and showing particularly one of the sections of the scale,

Figure 11 is a cross-sectional view taken on the line **11—11** of Figure 9 showing that portion of the scale mechanism that transmits the load from the end and intermediate extension levers to the weight-indicating and recording mechanism,

Figure 12 is a sectional view taken on the line **12—12** of Figure 11,

Figure 13 is a diagrammatic perspective view showing the lever system of the four-section three-span scale shown in Figures 8–12 inclusive, the portion of the system not being required for the converted scale being shown in dotted lines and the remainder in full lines,

Figure 14 is a view corresponding to Figure 13 but showing the simplified lever system required for a new installation of a short track scale constructed in accordance with this invention,

Figure 15 is a longitudinal sectional view taken on the line **15—15** of Figure 16,

Figure 16 is a transverse sectional view taken on the line **16—16** of Figure 15,

Figure 17 is a diagrammatic view showing dual trip mechanism used in conjunction with certain embodiments of my invention,

Figure 18 is an end elevational view of the same, and

Figure 19 shows another form of dual trip mechanism.

For a complete understanding of the invention, it will be helpful to consider first the problems which arise when the various standard methods of weighing are used with conventional track scales and then see how the use of my improved method and apparatus solves those problems in each case.

Weighing of freight cars while coupled together and in motion

Before freight cars are moved to their ultimate destination, it is necessary to obtain the individual car weights and the economical and most efficient manner of doing this is while the cars are coupled together and in motion. If the cars are all of the same length, say for example 40 feet from the front axle to rear axle with 10 feet between the adjoining axles of adjacent cars (see Figure 1) and a 50-foot scale is available (i. e. a scale with a weigh rail length of 50 feet) having a trip located, say, one foot from the leaving end of the weigh rail and operable on every fourth wheel actuation to record the weight on the scale, the scale would furnish one with the weight of each car going over the scale. But, if a shorter car, say a 30-foot car happened to be in the train and all other conditions were the same, one or more wheels of the car following it would be on the scale when the trip operated to record the weight, and, obviously an incorrect weight for the cars would be recorded. Hence, for weighing cars coupled together and in motion by conventional methods, all cars must be of substantially the same length and the scale used must have a weigh rail suited for that length of car.

Now, by contrast, suppose instead of using a 50-foot scale for the conditions stated above, a scale having a weigh rail **22** (Figure 2) of 13 feet in length were used with a trip **23** at the leaving end of the scale located 6 inches from that end, or 12 feet 6 inches from the entering end of the weigh rail. With this length of scale and with cars coupled together and in motion, only one car truck of substantially any conventional freight car, no matter in what order they are coupled together, can be on the weigh rail at one time; and, by arranging the trip to record the weight on the scale when actuated by the front wheel of each truck (by using a two-cycle trip mechanism), the weight carried by each car truck may be recorded.

Hence, since the maximum total weight of a loaded freight car of greatest capacity does not ordinarily exceed 50 or 55 tons, and the maximum weight which can be imposed by three driver wheels of a locomotive on the scale, would not ordinarily exceed 110 tons, a two-section scale (i. e., a scale having two main pivot points) made in accordance with this invention could have a sectional capacity based upon these maximum loadings.

These maximum loadings are well within the sectional capacities of conventional scales, in fact, they are considerably lower than usual. As a result, the dead rail which is ordinarily used on light duty scales, and many times on heavy duty scales, to avoid damage to the scale mechanism by locomotives and other heavy equipment, which would cause overloading of the scale, may be entirely eliminated, resulting in substantial savings due to the elimination of dead track structure, the supports for the dead rail, and the time required for dead rail switching, etc.

In new constructions the scale parts may be made correspondingly lighter due to the lower loads imposed upon the scales. In converted scales the use of the shorter weigh rail actually increases the capacity of the scale and eliminates the need for the dead rail with its consequent disadvantages.

The mention of a 12 foot 6 inch distance between the entering end of the weigh rail and the trip is not an arbitrary selection of length but one which in itself has certain advantages, as will hereinafter appear. Theoretically, for multiple draft weighing of freight cars, that is the separate weighing of the loads on each car truck of a car, a weigh rail need be no longer than the greatest distance between the axles of any commonly used or conventional freight car truck. By far the greatest number of freight cars in use today have car trucks with axles on 5 foot 6 inch centers, and, if it were possible to employ scale mechanism that would instantaneously indicate and record the weight applied to the scale, a weigh rail of 5 feet 6 inches or slightly more, as indicated at **20** in Figure 2 with a trip **21** immediately adjacent to the leaving end of the rail for actuating the recording device, would serve the purpose.

Unfortunately, a certain amount of time is required for scale mechanism to stabilize itself upon the application of a load, and it is therefore desirable to have the weigh rail as long as possible, consistent with other influencing factors, to give the scale as much time as possible to stabilize as a car truck is being run over the weigh rail before recording the weight. Obviously, the longer the permissible length of the weigh rail, the greater the speed with which the cars may be run over the scale.

One limiting factor in determining how long the weigh rail can be for multiple draft weighing of cars coupled and in motion is the distance between the front wheels of the leading truck of a car and the front wheels of the rear truck of the same car. Of course, the weigh rail could be increased in length over this distance to the extent of the coupling distance (as shown at C in Fig. 7), but this would not result in any practical benefit because such additional length of weigh rail would not be utilized for weighing purpose.

In order to have a weigh rail of maximum length, however, as set forth above, it is necessary to use two alternately effective trips **25** and **26**, the first, or trip **25**, operating to record the weight on the scale when actuated by the front wheel of a rear truck after the front truck of the same car has left the scale and before the front truck of the succeeding car has reached the scale, and the other, or trip **26**, operating to record the weight on the scale when actuated by the front wheel of a front truck, before the rear truck of the same car reaches the scale and after the rear truck of the preceding car has left the scale.

The maximum permissible length of a weigh rail using two trips, as shown in Figure 2, depends upon the extent to which the scale is intended to accommodate cars of varying length. Excluding certain types of ore cars from consideration which have a very short overall wheel base (on the order of 20 feet from outside axle to outside axle), almost every other conventional freight car could be weighed while coupled in a

train and in motion if the weigh rail is no longer than approximately 31 feet 6 inches, making use of alternately acting trips **25** and **26** for determining the instant at which the scale weight is to be recorded. The length of 31 feet 6 inches is based upon an assumed minimum overall wheel base length of 30 feet (i. e. front axle of the front truck to rear axle of the rear truck), a minimum distance of 7 feet between the adjoining axles of coupled cars, and the conventional 5 foot 6 inch spacing of car axles within a given truck. Obviously, the figure of 31 feet 6 inches may vary somewhat according to the conditions assumed.

Although the above indicates certain limiting factors determining the permissible length of a weigh rail according to my invention, it is preferred that the weigh rail be less than approximately 15 feet in length with a trip preferably located at approximately 12 feet 6 inches from the entering end of the weigh rail in order to gain certain additional advantages. In the first place, this length is adequate to give the scale time to stabilize after each truck has come upon the scale for train speeds suitable for the task performed by the weighmaster or other person responsible for the weighing of the cars. Probably of greater importance, however, is the fact that a scale having a weigh rail, the length of which is less than substantially 15 feet, cannot have more than three driver wheels of substantially any conventional freight locomotive on the scale at one time. This is because the minimum distance between driver wheels on such locomotives is approximately 5 feet, thus making the minimum dimension for "A" in Figure 7 ten feet.

Since the maximum load imposed on a scale by three pairs of driver wheels of substantially any conventional freight locomotive does not exceed approximately 110 tons and, since it is impossible to get two freight car trucks on a weigh rail of substantially 15 feet or less at the same time (if possible, the total maximum loading of the two trucks would not exceed 105 tons), it means that a weigh rail of substantially 15 feet or less may have a sectional capacity, assuming a two-section scale, of 60 tons and thereby be adequate for all railroad rolling stock that would pass over the scale and hence no dead rail is needed.

Although a scale having a weigh rail length of substantially 15 feet enables low capacity scale mechanism to be used, as pointed out above, without the use of a dead rail, it is preferred that the weigh rail be on the order of 12 feet 6 inches in length in order to gain certain additional advantages. It has been determined that substantially all conventional freight cars, with the exception of certain types of ore cars, have a minimum distance between the corresponding axles of the adjacent trucks of coupled cars, as indicated at B in Figure 7, of approximately 12 feet 6 inches; therefore a weigh rail of this length precludes the possibility of having more than one car truck on the weigh rail at any one time, and using a trip for operating the scale recorder immediately adjacent to the leaving end of the weigh rail, the maximum possible time is provided for the scale to stabilize itself after receiving the car truck that is to be weighed.

Since the speed at which the cars may be weighed is limited by the time required for stabilization of the scale, obviously maximum weighing speed is obtained by providing stabilizing time, as described above. By a multiple draft weighing method and apparatus the speed at which cars may be weighed is materially increased over that permissible for conventional single-draft weighing of freight cars coupled and in motion. From what has been said, it is apparent that a track scale having a weigh rail length of substantially 12 feet 6 inches and sectional capacities of 60 tons can, without the use of a dead rail, accommodate all classes of freight cars, with the exception of special ore cars, and weigh them while coupled together and in motion at a substantially greater speed than heretofore possible.

Furthermore, this type of weighing enables uneven distribution of the car load on the car trucks to be discovered and avoids the possibility of overloading any particular car axle or journal.

For ore cars or any other type of car that may have exceptionally short overall wheel base, it has been found that a scale having weigh rail length of less than substantially 10 feet, and preferably having a length of substantially 8 feet 6 inches is the most desirable because it prevents more than one truck of ore cars coupled together from being on the weigh rail at any one time. The 8 foot 6 inch length of the weigh rail is based upon the fact that the distance B (Figure 7) for most ore cars coupled together is that amount. This length, however, may vary considerably within the teachings of this invention.

Gravity weighing

In the gravity weighing of freight cars each car after being loaded is put over the hump in the classification yard and made to travel by gravity over the scale. The common practice is to have a scale having a weigh rail long enough to accommodate both trucks of any car to be weighed on the scale, and, in addition, the rail must be long enough to permit the scale to become stabilized after both trucks of the car being weighed are on the scale. Hence, a car having an overall wheel base of 40 feet might be weighed on a track scale having a weigh rail length of 50 feet allowing approximately 10 feet for the scale to stabilize during the weighing operation. This is illustrated in Figure 3.

If a car is to be weighed having a length too great for the particular scale, two-draft spot weighing is used. This consists in moving one truck of the car onto the weigh rail and weighing that truck and the load which it carries while the car is stationary, then moving the other car truck onto the rail, stopping the car, and then weighing that truck alone with the load that it carries.

According to my invention, by using a shorter track scale not only may I obtain many economies in original cost, and cost of maintenance and operation, but I also achieve much greater flexibility in the length and weight of car that can be weighed on the scale.

Theoretically, a weigh rail of 5 feet 6 inches if used with scale mechanism that would provide instantaneous weight indication and recording would be satisfactory. Since scale mechanism of this kind is not available, a longer weigh rail must be used, and in general, the longer the weigh rail, the greater the speed at which the car being weighed by the scale can be moved over the scale. By using two trips, one at, say, approximately 20 feet from the entering end of the scale, and the other adjacent the leaving end, almost any existing gravity scale can be converted to a multiple draft motion weighing scale with the 20 foot trip being used to record the weight of the front truck and the trip at the end of the scale being used to record the weight of the rear truck. This modification of existing scales would have the advantage of enabling the scale to handle cars which heretofore have been too long for the scale without resorting to multiple draft spot weighing methods.

Since substantially all conventional freight cars, with the exception of special classes of ore cars, have not less than a 30 foot overall wheel base (i. e. measured from outside axle to outside axle), it follows (assuming 5 feet 6 inches between axle centers for each truck) that a scale having a weigh rail **27** (Figure 4*a*) 24 feet 6 inches in length would enable multiple draft gravity weighing of substantially all conventional freight cars exclusive of ore cars with the use of only one trip mechanism **28** located at the leaving end of the weigh rail, because with this length of rail not more than one car truck could be on the rail at any one time and maximum time would be afforded for the scale to become stabilized after the truck was on the scale, thereby enabling the cars to be moved over the scale at the greatest possible speed, consistent with the response of the weighing mechanism to loads imposed on the scale.

In gravity weighing, it is customary to provide spur tracks so that locomotives and other heavy rolling stock need not pass over the scale, so by providing a scale having a weigh rail not more than approximately 24 feet 6 inches in length, not more than one truck of substantially any conventional freight car, exclusive of ore cars, can be on the scale at any one time, and the scale may have a correspondingly lower capacity than scales heretofore used for this purpose. In other words, the total capacity would not have to be more than 60 tons, which means that for a two-section scale each section would not have to have a capacity of more than 30 tons. Present scales used for gravity weighing may be required to carry total loads up to twice these amounts and must be made correspondingly larger to carry these loads.

Although it is desirable to have the weigh rail for gravity weighing as long as possible, consistent with the limiting factors mentioned above in order to enable the speed at which the cars are moved over the scale to be as great as possible, certain advantages are gained by having a weigh rail the length of which is on the order of 18 feet 6 inches. With a weigh rail of this length and scale capacity suitable for the purpose, the scale may be used for either gravity weighing or the weighing of cars in motion and coupled together. This is illustrated in Figure 4*b*. The weigh rail is indicated at **29** and has a trip **30** located approximately 12 feet 6 inches from the entering end of the rail and another trip **31** located adjacent to the leaving end of the rail. When the scale is used for gravity weighing, the trip **30** is rendered inoperative and only the trip **31** is used, the weigh rail being short enough so that only one truck can be on the weigh rail at one time.

When the scale is used for multiple draft coupled and in motion weighing, the trip **30** is used for weighing the rear truck of each car and the trip 31 for recording the weight of the front truck of each car. Assuming, for example, that the rear truck of car 32 is on the scale with the cars moving in the direction indicated by the arrow, when this truck reaches the trip 30, the weight of this truck will be recorded. For the rear truck to move off of the scale, it must move the six additional feet from the trip 30 to the leaving end of the weigh rail, plus 5 feet 6 inches for the rear wheel of that truck to get off of the rail, or a total of 11 feet 6 inches. While this is taking place, the front truck of car 33 has moved upon the weigh rail and the front wheel of that truck has moved 11 feet 6 inches onto the weigh rail. There are still 7 feet for the front truck of car 33 to travel before it reaches the trip 31 and this is the same distance that the rear truck of car 32 had to travel after being completely on the weigh rail before reaching the trip 30. Hence, in both cases, 7 feet of car travel is provided for enabling the scale to stabilize.

Locomotive scale

Locomotive wheel load scales now used comprise a series of weigh rails separated by dead rails for obtaining the static weights for each of the wheel supports for the locomotive. The scales are tremendously expensive and cumbersome and the scales must be designed for the particular type of locomotive to be weighed. A scale of this type is diagrammatically shown in Figure 5, and for a more complete description of conventional locomotive wheel load scales, see Railway Engineering and Maintenance Cyclopedia, 1942 Edition, published by Simmons-Boardman Publishing Company, p. 714.

Since the principal purpose of weighing the locomotive is to obtain the distribution of the load on the driver wheels rather than the total weight of the locomotive, it is possible with my invention to obtain this information, as well as the total weight of the locomotive, by the use of scale mechanism of far simpler construction than has hitherto been used. For example, instead of using the multiple scale arrangement shown in Figure 5, it is possible with my invention to employ a weigh rail 34 of not more than approximately 5 feet in length, but in this case the weigh rails on opposite rails of the track are preferably, though not necessarily, connected to separate scale mechanisms and recorders. By providing a trip 35 at the leaving end of each weigh rail, each driver wheel as it passes over the scale will actuate the recorder of its respective scale mechanism and record the weight imposed on the scale by that wheel. The information furnished by the record tape then enables corrections to be made in the distribution of the load.

The dynamic weighing of locomotives, first in one direction and then in the other, gives additional information, particularly concerning the shifting of load due to play of parts.

Theoretically, the weigh rail for a locomotive of this type need be no more than the length necessary to support a single driver wheel, possibly two or three inches, but, since time is required for scale stabilization, a length of substantially no more than 5 feet is desirable because substantially all conventional freight locomotives have a spacing of a least 5 feet between driver axles.

Modification of existing scales

In Figures 8–13 inclusive is shown a conventional four-section, three-span, 40-foot scale which has been modified to incorporate the teachings of this invention. The parts of the original scale which are not used as a part of the modified scale are shown in dotted lines, while those retained are shown in full lines.

In this case the scale is one used for weighing cars while in motion and coupled together and comprises four sections 40, 41, 42 and 43 mounted in a scale pit 44 and having a weigh bridge with three spans, one indicated at 45 between the sections 40 and 41, another indicated at 46 between the sections 41 and 42, and the third indicated at 47 between the sections 42 and 43. The weigh rail originally extended from 48 to 49 and the load was transferred from the weigh rail through the three spans of the weigh bridge to the various levers and connections constituting the scale mechanism. These levers and connections included a pair of main levers 50 and 51 at each section (see Figure 13), end extension levers 52 and 53 and middle extension levers 54 and 55, which, together take the load from the main levers and transmit it to the scale beam through a transverse extension lever 57, beam rod 58, shelf lever 59 and scale beam connecting rod 60. Scale mechanism of this type is well known and further description is believed unnecessary, particularly in view of the diagrammatic representation of the scale mechanism in Figure 13.

When the entire 40-foot weigh rail was used, the three components 61, 62 and 63 were each supported on their respective spans of the weigh bridge by rail chairs 64, as shown in the center span section. The dead rail track 65 which crossed the scale was supported by transverse I beams 66 anchored in the side walls of the scale pit with cast iron blocks 67 interposed between the I beams and the dead rail for supporting the latter on the I beams.

In converting the scale to one embodying the teachings of this invention, the rail chairs supporting the components 61 and 63 of the weigh rail were removed and these rails are mounted and supported in the same manner as the dead rail on the transverse I beams 66. Blocks 68 and 69 are placed under the end extension levers so that the middle extension levers 54 and 55 receive their entire loading from the center span or weigh rail 62.

A deck 70 is customarily provided over the scale pit and is supported by the dead rail I beams 66. For rigidity the two parallel sides of the weigh bridge are connected together by cross members 71 and connecting braces 95, as shown in Figures 10 and 16.

The scale pit 44 has a neck or side extension 72 which receives the power end of the transverse extension lever 57, as shown in Figures 11 and 12. The scale beam 73 of the scale is suitably mounted above the neck 72 and the power end 74 of the scale beam is connected by a rod 75 to automatic weight-indicating and recording apparatus, designated 76 which includes a spring counterpoise, not shown, and a dashpot 77, such, for example, as the totalizing apparatus shown in Page Patent No. 2,406,897. Weight-indicating and recording mechanism of this type is well known and is characterized by the fact that when the trip associated with the weigh rail is actuated, the weight indicated by the scale is automatically printed upon a tape or card to make a suitable record of the weights being determined. The following United States Letters Patent illustrate weight-indicating and recording mechanism of this type, including trips for operating the mechanism:

Amet	380,672	Apr. 10, 1888
Amet	392,531	Nov. 6, 1888
Amet	413,880	Oct. 26, 1889
Goetz	651,845	June 19, 1900
Goetz	778,359	Dec. 27, 1904
Goetz	946,600	Jan. 18, 1910

New scale construction

The enormous saving in cost of scale construction using my invention can be shown by referring to Figures 15 and 16 which illustrate how a short track scale may be built with simplified construction and relatively low capacity sections.

In this case the scale pit **78** is correspondingly smaller, and, assuming a weigh rail **79** of say 12 feet 6 inches or thereabouts, the sectional capacity of each of the two sections **80** and **81** need not exceed 60 tons and yet permit all classes of rolling stock, including locomotives, to pass over the weigh rail without overloading the scale. The ends of the approach track **82** are supported by transverse I beams **83** anchored in the sides of the pit. The transverse I beams **84** which extend across the pit between the rail chairs **85** are used merely to support the deck **86**, and, as compared with the transverse I beams ordinarily used for supporting a dead rail, are much lighter in section.

Since each of the sections **80** and **81** need have a sectional capacity of only 60 tons, their components may be correspondingly lighter, and the end extension levers **87** and **88** which transmit the load from the main levers **89** and **90** of the sections **80** and **81** to the transverse extension lever **91** are likewise of lighter construction. Reduction of the pit size, elimination of middle extension levers, the main levers associated therewith, and two spans of the weigh bridge make for a great savings in initial cost of construction. The elimination of the dead rail and its support, switches, etc. provide added savings in cost, to say nothing of the operational savings resulting from being able to run a locomotive over the scale without dead rail switching.

Any kind of suitable trip mechanism, such as indicated at **92**, may be used adjacent the leaving end of the weigh rail **79** and its actuation of the weight-recording apparatus is clearly disclosed in the prior art patents, hereinbefore referred to.

Totalizer

It is contemplated that the automatic weight-indicating and recording mechanism may include means for recording not only the individual weights of the car trucks passing over the scale but also automatically add and record the combined weights of the two trucks constituting each car. This may be done by the use of any suitable known totalizing device.

Alternately operable dual trip mechanism

In the patents heretofore referred to for their disclosure of weight-indicating and recording mechanism, certain trip mechanisms are shown, some of which are adaptable to the purposes of this invention. For certain specific uses, however, I prefer to use dual trip mechanism, such as shown in Figures 17–19 inclusive.

In the embodiment of trip mechanism shown in Figures 17 and 18, the alternating effective trips **25** and **26** shown in Figure 2 may be connected to a pawl and ratchet mechanism, generally indicated **100**, for operating the platen hammer **101** which records on tape **102** the scale marking on that portion of the scale wheel **103** opposite the hammer **101**.

The pawl and ratchet mechanism includes a ratchet wheel **104** having eight ratchet teeth **105** on its periphery. The wheel is driven by dual pawl mechanisms, one of which is actuated by the pivoted trip **25** and the other by the pivoted trip **26**. The pawl mechanism operated by the trip **26** drives the ratchet wheel in a counterclockwise direction and comprises an arm **106** having a pivoted pawl **107** yieldingly held in engagement with the ratchet wheel **104** by a spring **108**, but limited in its movement by the spring **108** by a pin **99** so that the end of the pawl normally just clears the low part of the ratchet wheel while still engaging the teeth **105**. The arm **106** is connected to the trip **26** by any suitable means, such as a link **109**.

The pawl mechanism operated by the trip **25** drives the ratchet wheel in the same direction and likewise comprises an arm **110** carrying a pivoted pawl **111** held in engagement with the ratchet wheel by a spring **112** but limited in its movement by the spring **112** by a pin **113** so that the end of the pawl normally just clears the low part of the ratchet wheel while still engaging the teeth **105**. The arm **110** is connected to the trip **25** by a link or other connection **114**.

The ratchet wheel **104** is fixedly mounted on a shaft **115** and both are movable axially of the shaft by a suitable bifurcated shifting lever, generally indicated **116**, between two positions, one of which is shown in Figure 18 in full lines, and the other in dotted lines, as shown at **117**. During the movement, the pawl-carrying arms **106** and **110** remain stationary. In the retracted or full line position, pins **122** and **123** projecting laterally from the face of the ratchet wheel opposite the sixth and eighth teeth are adapted to strike the arm **120** of a bell crank lever **121** to drive the hammer **101** into printing engagement with the dial wheel **103**. It has been determined that when dual trip mechanism is to be used in the manner shown in Figure 2 for weighing cars coupled together and in motion, the weight on the scale should be automatically recorded for every sixth and eighth actuation of either of the two trips **25** and **26**; and, since the trips **25** and **26** are each operable to rotate the ratchet wheel one notch when actuated, the pins **122** and **123** will effect the automatic recording of the weight on the scale at the proper time.

Using the same scale for gravity weighing of uncoupled cars, it is desirable to use only the trip **26** located at the leaving end of the rail and this is readily accomplished by shifting the lever **116** to move the ratchet mechanism to its dotted line **117**. In this position the pawl **111** is out of engagement with the ratchet wheel and pins **118** and **119** which are located opposite the second and fourth teeth, respectively, of the ratchet wheel are brought into position where they too will actuate the printing arm **120**. In this way the mechanism has been converted to a two-cycle single-trip device from a dual trip mechanism operating on every sixth and eighth actuation of either trip.

The pin **113** holds the pawl **111** in a sufficiently retracted position so that on operating the lever **116** to move the ratchet mechanism to its full line position shown in Figure 18, the pawl **111** will clear the low portion of the wheel and fall into proper engagement.

In the embodiment of the invention shown in

Figure 19, the dual trip mechanism is electrically operated and comprises pawl and ratchet mechanism, generally designated 124, controlled by the trip 26 and pawl and ratchet mechanism 125 controlled by the trip 25. Each pawl and ratchet mechanism comprises a ratchet wheel 126 having four teeth on its periphery, as indicated at 127, and the ratchet wheels are rotated in a counterclockwise direction by an arm 128 carrying a pivoted pawl 129 constantly urged into engagement with the ratchet wheel by a spring 130. The arm is normally held in the position shown in Figure 19 by a spring 131 and rotation of the ratchet wheel is effected by a solenoid 132 associated with each trip mechanism, which in turn is connected by a jointed arm 133 to the driving arm 128 of the pawl and ratchet mechanism.

The pawl and ratchet 124 has a laterally extending pin 134 which is 180 degrees out of phase with a similar pin 135 on the pawl and ratchet 125. A pair of switches 136 and 137 are oppositely disposed about the shaft 138 which rotatably supports the ratchet wheel of the mechanism 124 and a single switch 139 is associated with the pawl and ratchet mechanism 125 in the same position as the switch 137. The switch arms of these switches are adapted to be engaged by the pins 134 and 135 and closed temporarily while the pin travels past the arm.

A solenoid-operated platen hammer 140 is mounted above the scale wheel 141 which carries suitably inked scale indicia on its periphery, so that when the solenoid 142 is energized, the hammer 140 is pressed against the wheel and a record of the scale indicia opposite the platen hammer 140 is recorded on the moving record tape 143. The platen hammer 140 is normally held in raised position by a spring 144.

The solenoids 132 which operate the pawl and ratchet mechanisms are in parallel circuits and either may be energized whenever the trip mechanism associated therewith closes the contacts associated with the particular trip. The contacts for the trip 26 are indicated at 145 and those for the trip 25 are indicated at 146. The switches 136, 137 and 139 are connected on one side to a lead 147 and on the other side are connected through the solenoid 142 to the other side of the line through conductor 148.

The single-pole double-throw switch 149 connects one side of the line alternatively to switch 136 or switch 139 for a purpose now to be described.

When the track scale is being used for weighing cars coupled together and in motion, the switch arm 150 of the switch 149 is moved to a position where it makes contact with lead 151 thereby energizing switch 139 and rendering switch 136 inoperative. This means that on every fourth actuation of the trip 26, the pin 134 will operate the switch 137 thereby energizing the solenoid; and likewise on every fourth actuation of the trip 25, the pin 135 will actuate the switch 139 and energize the solenoid 142 to record the weight then on the scale. Since the pins 134 and 135 are 180 degrees out of phase, the pawl and ratchet mechanism 124, if set properly, will actuate the weight recorder whenever the front wheel of the rear truck of a car strikes the trip 25, and, similarly, the pawl and ratchet mechanism 125 will operate the weight recorder whenever the front wheel of the front truck of a car strikes the trip 26.

When the scale mechanism is being used for gravity weighing of uncoupled cars, it is desirable to have only the trip 26 operate the weight recorder and this should be done for each second actuation by a car wheel. This is accomplished in the present embodiment of the invention by throwing the switch 149 to cause the switch arm 150 to be in contact with the lead 152, thereby energizing the switch 136 and deenergizing the switch 139. The pawl and ratchet mechanism then becomes a two-cycle counter and the desired result is effected.

Definitions

Throughout the specification and claims it should be understood that the expression "Conventional Freight Car" refers to commonly used freight cars of the two-truck, four-wheels-per-truck type used in the United States as shown in Car Builders' Cyclopedia, 1943 Edition, published by Simmons-Boardman Publishing Company, and similarly the expression "Conventional Freight Locomotive" refers to commonly used freight and switching locomotives used in the United States as shown in Locomotive Cyclopedia, 1944 Edition, published by Simmons-Boardman Publishing Company.

It should also be understood that the terms "trip" and "trip mechanism" should be given a broad interpretation to include known equivalents of mechanical trip devices such, for example, as inductive, photoelectric, and other position-responsive devices.

I claim:

1. A track scale for weighing freight cars of varying length and capacity while in motion and while coupled together, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, said weigh rail being of a length less than the distance between the front wheel axes of front and rear trucks of the shortest car being weighed but sufficiently longer than a car truck wheel base to permit the truck to be scale borne a sufficient length of time to secure accurate weight, and means including a trip mechanism responsive to the position of a car with respect to the weigh rail and operatively connected to the weight recording mechanism, for actuating said weight recording mechanism each time that a single car truck is scale borne.

2. A track scale according to claim 1 in which the length of the weigh rail is more than substantially 5 feet 6 inches and less than substantially 31 feet 6 inches.

3. A scale according to claim 1 in which the length of the weigh rail is more than substantially 5 feet 6 inches and less than substantially 15 feet.

4. A scale according to claim 1 in which the length of the weigh rail is more than substantially 5 feet 6 inches and less than substantially 15 feet, with the trip mechanism responsive to the leading wheel of the truck on the scale reaching a point substantially 12 feet 6 inches from the entering end of the rail.

5. A track scale for weighing locomotives in motion, said scale including a weigh rail, the length of which is not substantially more than 5 feet, whereby not more than one driver wheel of a conventional freight locomotive can be on the weigh rail at any given time, a weight recording mechanism associated with said weigh rail, and means including a trip mechanism responsive to the position of a locomotive with respect to the weigh rail, and operatively connected to said weight recording mechanism for actuating said weight recording mechanism each

time that a locomotive wheel is alone on said weigh rail.

6. A track scale for weighing freight cars of varying length and capacity while in motion and while coupled together in a train, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, and a trip associated with the weigh rail and responsive to the position of the car passing over the weigh rail, said trip being operatively connected to the weight recording mechanism and controlling operation thereof for recording said weight when actuated by a car passing over the weigh rail, said weigh rail having a length small enough so that not more than three driver wheels of a conventional freight locomotive can be on the rail at any one time nor more than one truck of any conventional freight car exclusive of ore cars whereby the scale may be constructed with a maximum capacity based upon one-half of the maximum weight of any car being weighed, and the load imposed by said three driver wheels.

7. A track scale in accordance with claim 6 in which the weigh rail is less than substantially 15 feet in length and in which the trip is located adjacent to the leaving end of the weigh rail.

8. A track scale for weighing freight cars of varying length and capacity while in motion and while coupled together, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, said weigh rail being of a length less than the distance between the front wheel axes of front and rear trucks of the shortest car being weighed but sufficiently longer than a car truck wheel base to permit the truck to be scale borne a sufficient length of time to secure accurate weight, and means including alternately effective trips spaced longitudinally of the weigh rail, and operatively connected to said weight recording mechanism, for actuating said weight recording mechanism each time that a single car truck is scale borne, one of said trips being actuated to effect recording of the front truck of each car and the other trip being actuated to effect recording of the rear truck of each car.

9. A track scale in accordance with claim 8 in which the length of the weigh rail is more than substantially 5 feet 6 inches and less than substantially 31 feet 6 inches, and in which said first mentioned trip is located adjacent to the leaving end of the weigh rail and the second mentioned trip is located not more than 15 feet from the entering end of the weigh rail.

10. A track scale for weighing freight cars of varying length and capacity while in motion and while coupled together, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, said weigh rail being of a length such that each wheeled component of each car being weighed will at some time be alone on the weigh rail, and means including a trip mechanism responsive to the position of a car with respect to the weigh rail and operatively connected to the weight recording mechanism for actuating said weight recording mechanism each time that one of said wheeled components is alone on the weigh rail, said weigh rail being less than 15 feet in length.

11. A track scale for weighing freight cars of varying length and capacity while in motion, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, said weigh rail being of a length less than the distance between the front wheel axes of front and rear trucks of the shortest car being weighed so that the capacity of the scale may be limited to less than the gross weight of any car being weighed, and means including a trip mechanism responsive to the position of a car with respect to the weigh rail and operatively connected to the weight recording mechanism for actuating said weight recording mechanism each time that a single car truck is scale borne.

12. A track scale for weighing freight cars of varying length and capacity while in motion, said scale comprising a weigh rail, weight recording mechanism for indicating the weight on the weigh rail at given times, and means including alternately effective trips spaced longitudinally of the weigh rail and operatively connected to said weight recording mechanism for actuating said weight recording mechanism each time that a single car truck is scale borne, one of said trips being actuated to effect recording of the front truck of each car and the other trip being actuated to effect recording of the rear truck of each car.

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The following references are of record in the file of this patent:

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