

G. LANGFORD.
METHOD OF AND MEANS FOR STRAIGHTENING RAILROAD RAILS.
APPLICATION FILED JULY 24, 1916.

1,314,877.

Patented Sept. 2, 1919.
4 SHEETS—SHEET 1.

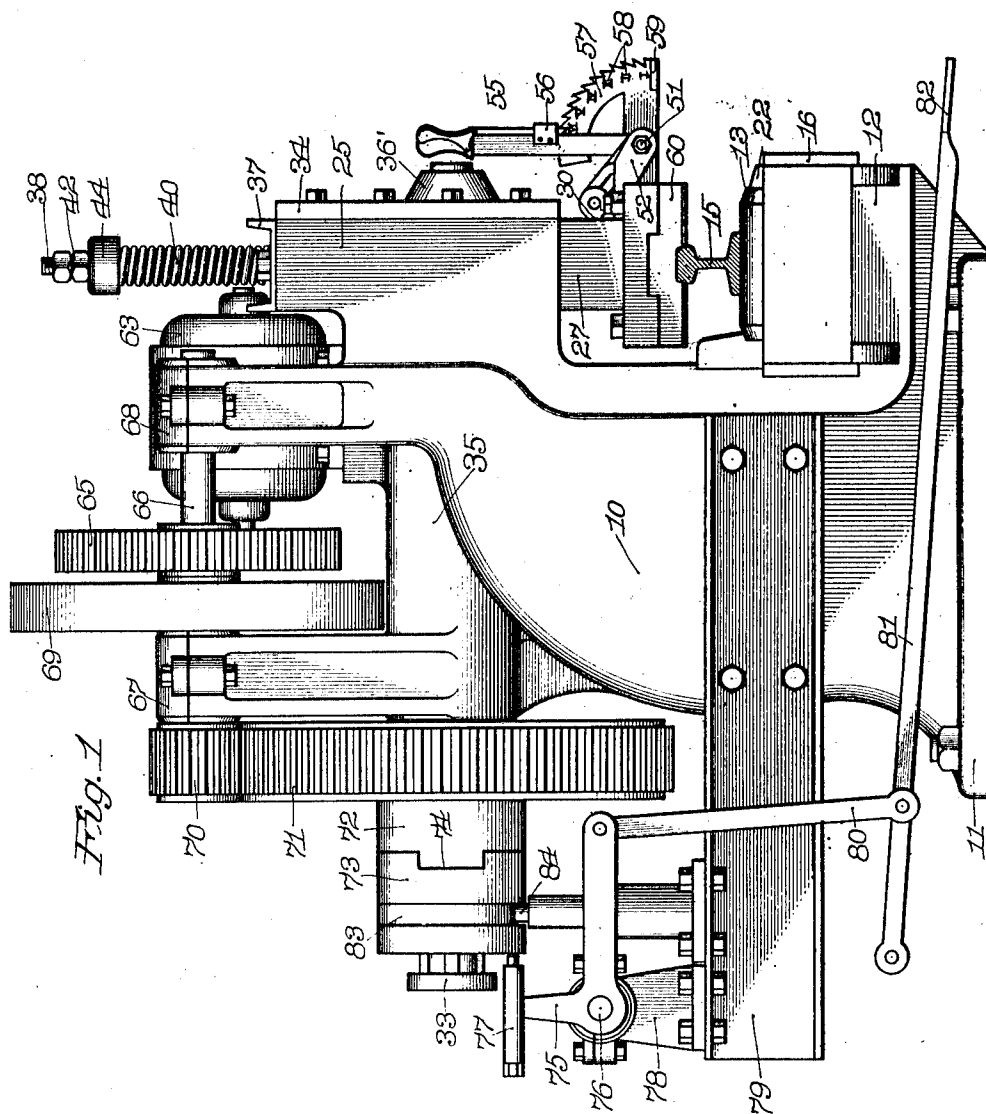


Fig. 1

Inventor
George Langford
By Brown, Hanson & Bottcher
Attorneys.

G. LANGFORD.

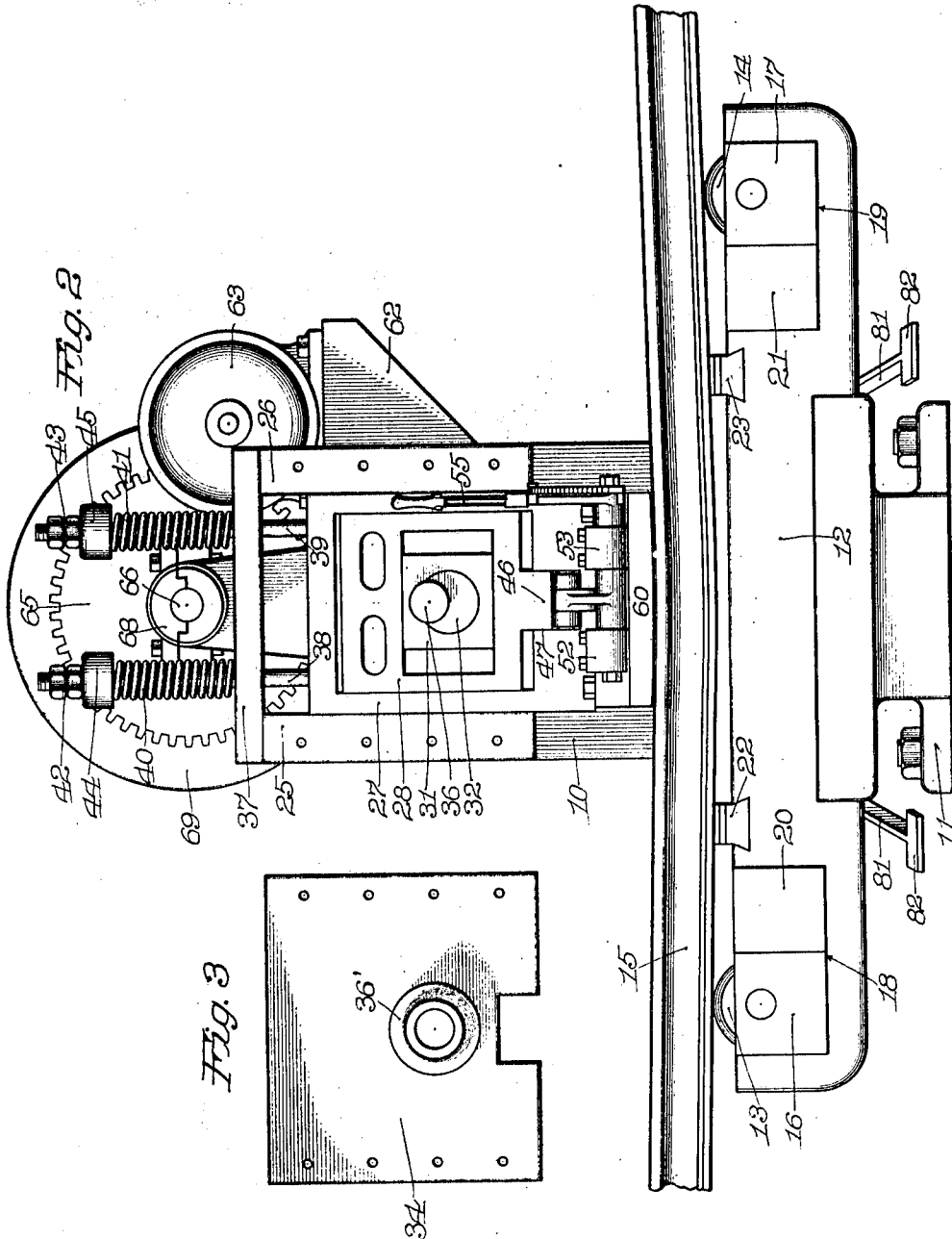
METHOD OF AND MEANS FOR STRAIGHTENING RAILROAD RAILS.

APPLICATION FILED JULY 24, 1916.

1,314,877.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 2.

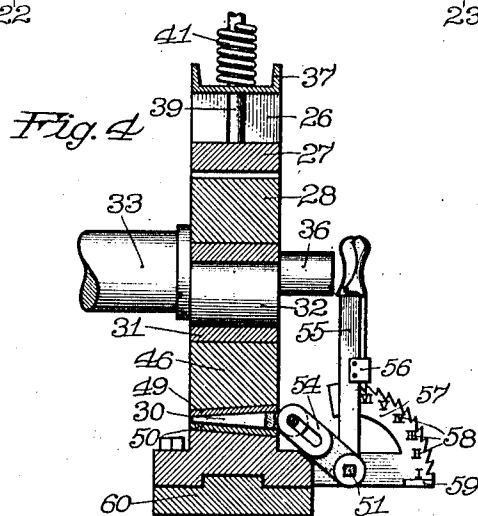
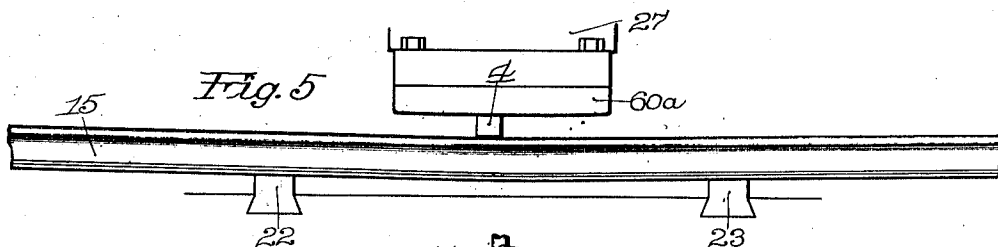
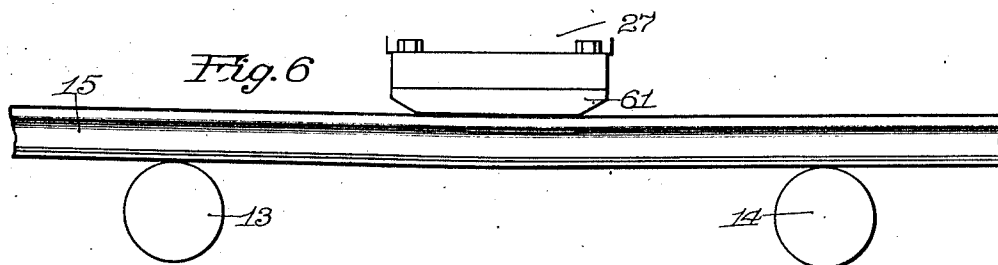
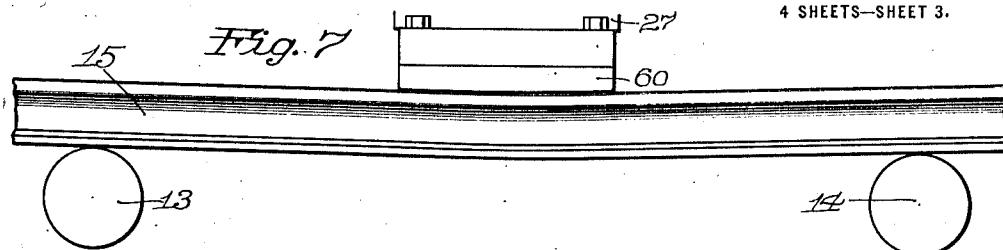


Inventor
George Langford
By Brown, Hanson & Bottcher
Attorneys.

G. LANGFORD.
METHOD OF AND MEANS FOR STRAIGHTENING RAILROAD RAILS.
APPLICATION FILED JULY 24, 1916.

1,314,877.

Patented Sept. 2, 1919.
4 SHEETS—SHEET 3.



Inventor
George Langford
By Brown, Hanson & Boettcher
Attorneys.

G. LANGFORD.
METHOD OF AND MEANS FOR STRAIGHTENING RAILROAD RAILS.
APPLICATION FILED JULY 24, 1916.

1,314,877.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 4.

Fig. 8

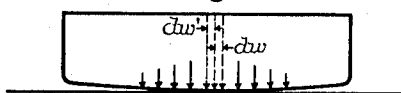


Fig. 9

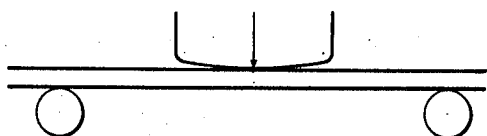


Fig. 13

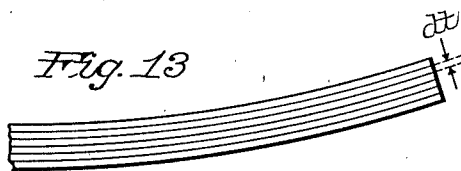


Fig. 10



Fig. 14

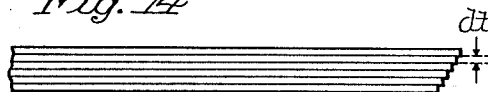


Fig. 11



Fig. 15

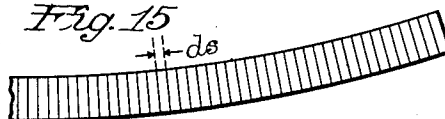


Fig. 12

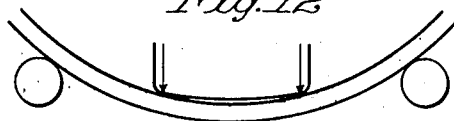
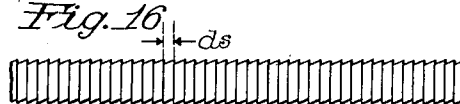


Fig. 16



Inventor
George Langford
By Brown, Hanson & Boettcher
Attorneys

UNITED STATES PATENT OFFICE.

GEORGE LANGFORD, OF JOLIET, ILLINOIS.

METHOD OF AND MEANS FOR STRAIGHTENING RAILROAD-RAILS.

1,314,877.

Specification of Letters Patent.

Patented Sept. 2, 1919.

Application filed July 24, 1916. Serial No. 110,835.

To all whom it may concern:

Be it known that I, GEORGE LANGFORD, a citizen of the United States, residing at Joliet, in the county of Will and State of Illinois, have invented a certain new and useful Improvement in Methods of and Means for Straightening Railroad-Rails, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a method of and means for straightening railroad rails.

Cold straightening of railroad rails is necessary since it is unpracticable to produce rails which are straight enough to be laid in tracks when they come from the cooling bed after being rolled.

The object of the invention is to provide a novel method of cold straightening rails and to provide an improved machine for accomplishing the same.

The following specification in connection with the accompanying drawings sets out in such full, clear and concise terms the nature of the invention, that those skilled in the art may practise and utilize the same.

Figure 1 is a side elevation of a machine embodying my invention;

Fig. 2 is a front elevation of the same with the front bearing plate removed;

Fig. 3 shows the front bearing plate in front elevation;

Fig. 4 is a diagrammatic section of the cross head, plunger and hammer face;

Figs. 5, 6 and 7 are diagrams indicating the manner of straightening rails of different degrees of stiffness;

Fig. 8 is a diagram illustrating the increased area of pressure of the hammer face upon the top of the rail;

Figs. 9, 10, 11 and 12 are diagrams illustrating the action of the hammer face upon the rails during the operation of straightening;

Figs. 13 and 14 illustrate the theory of straightening which the applicant's method and machine approaches; and

Figs. 15 and 16 illustrate the theory of straightening which the prior art approaches.

My invention aims to eliminate the destructive effect of localized straightening by applying a distributed force.

I have found that a number of important conceptions lie at the foundation of my in-

vention, one of which is that the width or area of contact of the engaging face of the hammer and the width between supports must be increased in proportion with the increase in stiffness and height of the rail and the machine which I have illustrated embodies in practical form the application of this basic doctrine.

In practising my invention I employ a machine of the type shown in Figs. 1 and 2.

A main frame 10 having a base portion 11 supports a bed or table 12 which bears the supporting rollers 13 and 14. The rail 15 to be straightened is rested upon the rollers 13 and 14 with the convex side upward. The rollers 13 and 14 are journaled in rectangular blocks 16 and 17 that are set into large rectangular notches or gains 18 and 19 formed in the face of the bed or table 12. The notches 18 and 19 are wider than the blocks 16 and 17 and the space is filled by suitable filler blocks 20 and 21. The filler blocks 20 and 21 may be removed and the roller blocks 16 and 17 moved to the inward position when the distance in span between the supporting rollers 13 and 14 is to be shortened. In this case the blocks 16, 20, and 17, 21 are interchanged. Other suitable filler blocks may be employed upon each side of the roller blocks 16 and 17 where an intermediate position is desired. Anvil blocks 22 and 23 are dove-tailed into the table 12, these anvils being employed as will be described later in connection with straightening light weight rails and in straightening the rails near the end. The machine is also provided with suitable shims for raising the roller blocks 16 and 17 any desired degree.

It is to be understood that other means may be employed for securing lateral and vertical adjustment of the rollers 13 and 14, the means I have shown being the one preferred but not necessarily the only means which may be employed.

The main frame 10 is provided with a pair of guides 25, 26 between which a hammer frame 27 is slidably mounted. The hammer frame 27 provides suitable guides for a cross-head frame 28, these two frame parts being relatively adjustable with respect to each other by means of a suitable wedge 30 as will be described later. The cross head frame 28 provides suitable slides or bearings for the cross head 31 which fits about the cam or crank 32 formed on the main shaft 33. (See Fig. 4). The main

shaft 33 has bearings within the barrel 35 formed upon the main frame 10. The forward extension 36 of the shaft 33 which is of reduced diameter is provided with a suitable bearing 36' in the front plate 34 which is bolted in position upon the front of the ways 25 and 26. A channel bar 37 or the like is mounted upon the top of the ways 25 and 26, as shown in Fig. 2, and a pair of rods 38 and 39 pass up through the channel bars and are surrounded by suitable springs 40 and 41 in such manner as to support the weight of the hammer frame and connected parts. The tension on the springs 40 and 41 may be adjusted by means of the adjusting nuts 42, 43 and the washers 44, 45 at the tops of the rods 38 and 39. The cross-head frame 28 is provided with a depending projection 46 which fits into a notch 47 in the hammer frame 27, these parts being held in proper relation by means of the wedge 30 shown in Fig. 4. Removable liners 49 and 50 are provided as facings for the cooperating parts of the hammer frame and cross head frame. A shaft 51 is pivoted in a pair of lugs 52, 53 and a slotted lever 54 connects the shaft 51 with the wedge 30. A suitable controlling and indicating lever 55 is rigidly connected to the shaft 51 and is provided with suitable latch mechanism 56 which cooperates with the ratchet quadrant 57 to hold the wedge 30 in any position in which it is set in order to predetermine the force of the blow delivered to the rail. The quadrant 57 is provided with suitable indications 58 for indicating the setting of the wedge. A stop 59 limits the outward movement of the wedge 30 by engaging the lever 55. A suitable hammer face 60 is secured to the bottom of the hammer frame 27, the parts being suitably grooved or teed to insure alinement. The depth of the hammer face 60 is made considerably greater than the rail in order to permit of considerable variation in placing of the rail between the hammer face 60 and the rollers 13, 14.

The main frame 10 is provided with a suitable supporting bracket 62 which forms the bed for an electric motor 63 which is geared by means of the pinion, not shown, to the gear 65, mounted on the shaft 66. The shaft 66 is provided with bearings in the standards 67 and 68.

A suitable fly-wheel 69 is keyed to the shaft 66 and serves to equalize the load upon the motor 63. A pinion 70 is secured to the rear end of the shaft 66 and this pinion meshes with a large gear 71 mounted loosely upon the main shaft 33.

A suitable one stroke clutch arrangement is provided on the rear end of the shaft 33 for causing the plunger 27 to make one stroke and then stop in the raised position. A suitable clutch portion 72 is bolted to the gear 71 and normally idles on the shaft 33.

A cooperating clutch part 73 is keyed by means of feather keys or the like to the shaft 33 being normally held disengaged by suitable spring means. The two clutch parts 72 and 73 are suitably notched as shown at 74 to form a positive clutch. Suitable means for throwing in the clutch and holding the same in engaged position during one complete stroke is provided by the following means. A bell-crank lever 75 mounted on the shaft 76 has its vertical arm provided with a suitable engaging member 77 which is adjustable with respect to the clutch half 73. The shaft 76 is journaled in a suitable bearing supported by means of the post 78 upon a pair of channel bars 79 bolted at their front ends to the sides of the main frame 10. The other end of the bell-crank lever 75 is connected by means of a length 80, to the foot lever 81, the outer end of which may be provided with a suitable foot plate or pedal 82. For convenience in operation each side of the machine may be provided with a suitable lever and pedal. The clutch part 73 is provided with an eccentric groove 83 which is flush with the top surface as shown in Fig. 1. A suitable spring plunger 84 is adapted to lie in the groove 83 during the downward and return portion of the stroke. When the hammer is in the raised position the pin 84 rests against the part of the groove which is flush with the upward surface and at this time the spring means is therefore free to disengage the clutch parts 73 and 72. The particular arrangement of the one stroke mechanism that I have illustrated forms no part of the present invention and any other suitable mechanism may be employed instead for securing the effect of a clutch during a full stroke of the plunger. It is also apparent that other means than the springs 40 and 41 may be employed for holding the plunger in raised position, such, for instance, as causing a slight binding action of the plunger between the ways when the plunger is at the upper end of its travel. Counterweights may also be employed, although I find that springs are preferable to the use of counterweights. The rollers 13 and 14 may be replaceable by grooved rollers for holding the rail 15 in position to be engaged on its side. The operation of the device is as follows:

The machine stands normally with the plunger 27 raised so that the hammer face 60 is clear of the space to be occupied by the rail to be straightened. The indicating handle 55 is placed in a position approaching the horizontal or first position, the clutch parts 73 and 72 are separated and the motor is running. The rail straightener stands at the right hand side of the machine viewing the machine and the rail somewhat as shown in Fig. 1. The "gagger" stands

in front of the machine in position to set the wedge 30 and thereby control the stroke of the plunger 27 by means of the controlling and indicating handle 55. A rail which is to be straightened is laid upon the rollers 13, the machine is set for a light stroke and a few practice strokes are tried in order to note the effect upon the particular rail. The straightener sights along the rail 15, placing the part of the rail which is to be straightened beneath the hammer face 60 and gives his directions to the "gagger" for obtaining the proper depth of stroke. When it is desired to straighten the rail near the end, the extreme end, the rail is rested upon one of the anvils, such as 23, and is passed over the opposite roller as 13 and a suitable blow delivered to the rail to bring it to the required form. Similarly the opposite end of the rail may be straightened by resting the extreme end upon the anvil 22 and laying the rail upon the roller 14.

Suitable adjustment is provided on the machine for straightening rails of different sizes usually designated by the weight per yard. For instance in straightening 125 lb. rail, such as is indicated in Fig. 7, the rollers 13 and 14 will be spaced at their outermost position, as shown in Figs. 2 and 7. A hammer face 60 of a suitable width and contour is employed for delivering the stroke to the rail. For lighter sizes of rails the distance between the supports is decreased and the width of the hammer face is decreased.

For instance in Fig. 6 suitable parts are indicated for straightening 100 lb. standard rails. A hammer face 61 of less width is employed for securing the proper straightening effect. For light rails the supports 22 and 23 may be employed and a still narrower hammer face may be bolted to the plunger 27. For light sections of rails such as will not be damaged by the use of the gag, due to the relatively small stiffness and low height of the rail, a gag may be used in conjunction with the hammer face and wedge mechanism.

A certain relation is to be observed between the form and width of the hammer face, the height of the rail to be straightened and the distance between supports. If it were possible it would be desirable to have the straightening effects uniform over the parts which require straightening, so that if a rail had a definite camber along its entire length, it would be desirable to support the rail at its extreme end and deliver one single blow effective over the full length of the rail which would just overcome the said camber and leave the rail perfectly straight along its entire length. However, it is found to be essential to make the distance between the supports less than the full length of the rail because of the variation in curvature in a single rail which needs to be straightened.

Furthermore on an extremely long span it is very difficult to control the straightening effect upon the rail and if the rail is not strictly uniform from end to end a weak point in the rail would tend to yield and cause a kink without securing straightening of the rest of the rail. Hence the span over which straightening is to extend must be limited to an amount in which the straightening effect may be properly applied and controlled to produce the desired results.

I have found that there is no strict limit either to the width of the hammer face or the length of span or the height of the rail, but a fairly wide degree of variation may be employed within the teachings of my invention.

I have made numerous tests of various proportions of these quantities in order to find as nearly as possible the underlying requirements for securing straightening with as little damage as possible to the fiber of the rail. The action that occurs in the fiber of the rail is as is set elsewhere an actual displacement of the metal and as such is not governed by the well known laws of safe loading.

The following table represents the result of my experimental determination of the relation of the length of span l , the height of the section h , the width of the base h' , (for sidewise straightening) and width of hammer face a .

Section.	h .	h' .	l .	a .	
(a) A. R. A., 60 #.....	4½	4	54	9	100
A. R. A., 70 #.....	4½	4½	57	9½	
A. R. A., 80 #.....	5½	4½	61½	10	
A. S. C. E., 85 #.....	5½	5½	62	10½	
A. S. C. E., 90 #.....	5½	5½	64½	10½	
(a) A. R. A., 90 #.....	5½	5½	67½	11½	105
A. R. A., 100 #.....	6	5½	72	12	
A. S. C. E., 100 #.....	5½	5½	69	11½	
(b) A. R. A., 100 #.....	5½	5½	67½	11½	
Proposed, 125 #.....	6½	6	78	13	
Proposed, 150 #.....	6½	6½	81	13½	

For straightening rails where the height h greatly exceeds the width of base h' , I employ a hammer face and rollers which are provided with extensions on the sides that support the rail properly on its side and deliver the desired blow on the flange.

From the above table it may be seen that in each case I can make the width of hammer face substantially two times the height h of the rail and make the distance of span l substantially twelve times the height of the rail, or in equation form—

$$l = 12h = 6a$$

$$a = 2h = \frac{1}{6}l.$$

The desired effect to be obtained is a smoothing out effect rather than a sharp kinking.

The condition which I desire to approach is that illustrated in Figs. 13 and 14. Con-

sider the crooked rail shown in Fig. 13 to consist of a number of longitudinal laminations of minute thickness d , it can be seen that by stretching the laminations on the short side and compressing the laminations on the long side this rail may be brought to the straight condition without destroying the continuity of the rail. If the laminations be considered as entirely separate and they be brought to the straight form, as shown in Fig. 14, still the continuity of the rail is not broken.

The first consideration in practising my invention is to spread out the area of contact between the plunger and the face of the rail to be straightened over such a wide area that the pressure will not be destructive to the rail. Considering the effect of the gag 4, as shown in Fig. 20, it can be seen that where the stiffness of the rail l is very great, the pressure in lbs. per square inch upon the area of contact between the gag and the rail may be greater than the crushing strength of the metal and as a consequence there is incipient failure at the point where the gag touches the rail. According to my invention the use of the wide hammer face not only distributes the pressure over a large area but the convexity of the hammer face prevents a sharp contrast in the application of the pressure. Considering the diagram of Fig. 8 it can be seen that if the difference in pressure between the element dw and the element dw' is greater than a certain predetermined amount the rail would be marred, but where this pressure differs only in a relatively small degree there will be no marring of the rail.

As a consequence the stresses in the rail are so distributed that there is substantially no damage to the steel.

Figs. 9, 10, 11 and 12 are diagrams indicating the progress of the stroke during straightening. When the hammer face is just brought into contact with the rail the central part thereof is the only one which applies any pressure to the rail.

In straightening rails or the like it is necessary to actually strain the metal. That is to say, the work of straightening is carried on after the stresses are carried beyond the elastic limit as no permanent set is produced within the elastic limit.

Hence, in straightening a bar the formulæ relating to loading within the elastic limits do not apply. Three kinds of elementary stresses are recognized—tension, compression and shearing.

As explained in connection with Figs. 15 and 16 shearing is undesirable as it destroys the continuity of the rail. Tension and compression are permissible but these must be properly controlled.

The matter of obtaining a straightening effect of a desired amount is complicated by

this requirement for first bringing the stresses in the rail up to the elastic limit. The rail is first loaded to the point where the elastic limit is reached. This loading is naturally accompanied by a corresponding deflection. After the proper loading and the consequent deflection have been attained further loading is not as important as obtaining further deflection substantially without increasing the unit stresses any material degree.

That is to say, straightening a bar comprises two steps—first loading the bar to the point where the unit stresses in some part thereof reach the elastic limit, and second deflecting the bar to acquire the desired degree of set or straightening effect.

Naturally the first step cannot be accomplished without entailing deflection and the second step cannot be accomplished without increasing the loading but the merit of my invention lies in the fact that the unit stress is not increased greatly at any one point but instead is extended over a wider area.

This application is in part a continuation of the subject matter found in my prior application, Serial No. 51130 filed September 17th, 1915.

I desire that the above relation of the quantities l , h and a be construed liberally as I consider that I am the first to teach the rail straightening art how to obtain in actual practice a distributed blow in straightening rails as distinguished from the concentrated blow.

I claim:

1. The method of straightening rails which consists in supporting the rail to be straightened upon two supports spaced apart a distance substantially equal to twelve times the height of the rail to be straightened, then applying pressure upon the rail substantially midway between the supports and progressively spreading the pressure longitudinally along the rail toward each support a distance substantially equal to the height of the rail and sufficient to deflect the rail beyond the elastic limits of, but insufficient to disrupt the material.

2. In a machine for straightening rails, supports for the rails spread apart substantially twelve times the height of the rail to be straightened, a plunger arranged between the supports for applying pressure to the rail, a hammer face on the plunger having a width substantially twice the height of the rail and adapted to first contact with the rail substantially midway between the supports and to progressively apply pressure to the rail from the contact point toward each support, and means for predetermining the stroke of the plunger for regulating the amount of pressure to be applied.

3. In a machine for straightening rails,

supports for the rail, a reciprocable member
substantially midway between the supports,
a plunger for striking the rail operatively
related to said member and provided with
5 a hammer face substantially twice as wide
as the height of the rail to be straightened,
springs normally holding the plunger at the
upper limit of its movement, a transversely
movable wedge, manually insertible between

said member and said plunger for causing 10
said member to force the plunger down to
strike the rail, and means visible from the
end of the rail being operated upon for
determining the position of said wedge.

In witness whereof, I hereunto subscribe 15
my name this 21st day of July A. D. 1916.

GEORGE LANGFORD.