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RAILWAY SUPPLY CO.

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GENERAL OFFICES AND WORKS

KALAMAZOO - MICHIGAN

Kalamazoo Railway Supply Co. *Manufacturers*

TRACK *and* RAILWAY SUPPLIES

GENERAL CATALOGUE NUMBER 20

WORKS AND GENERAL OFFICES:

Kalamazoo, Michigan, U. S. A.

Cable Address—"VELOCIPEDE"

Moore Track Drill

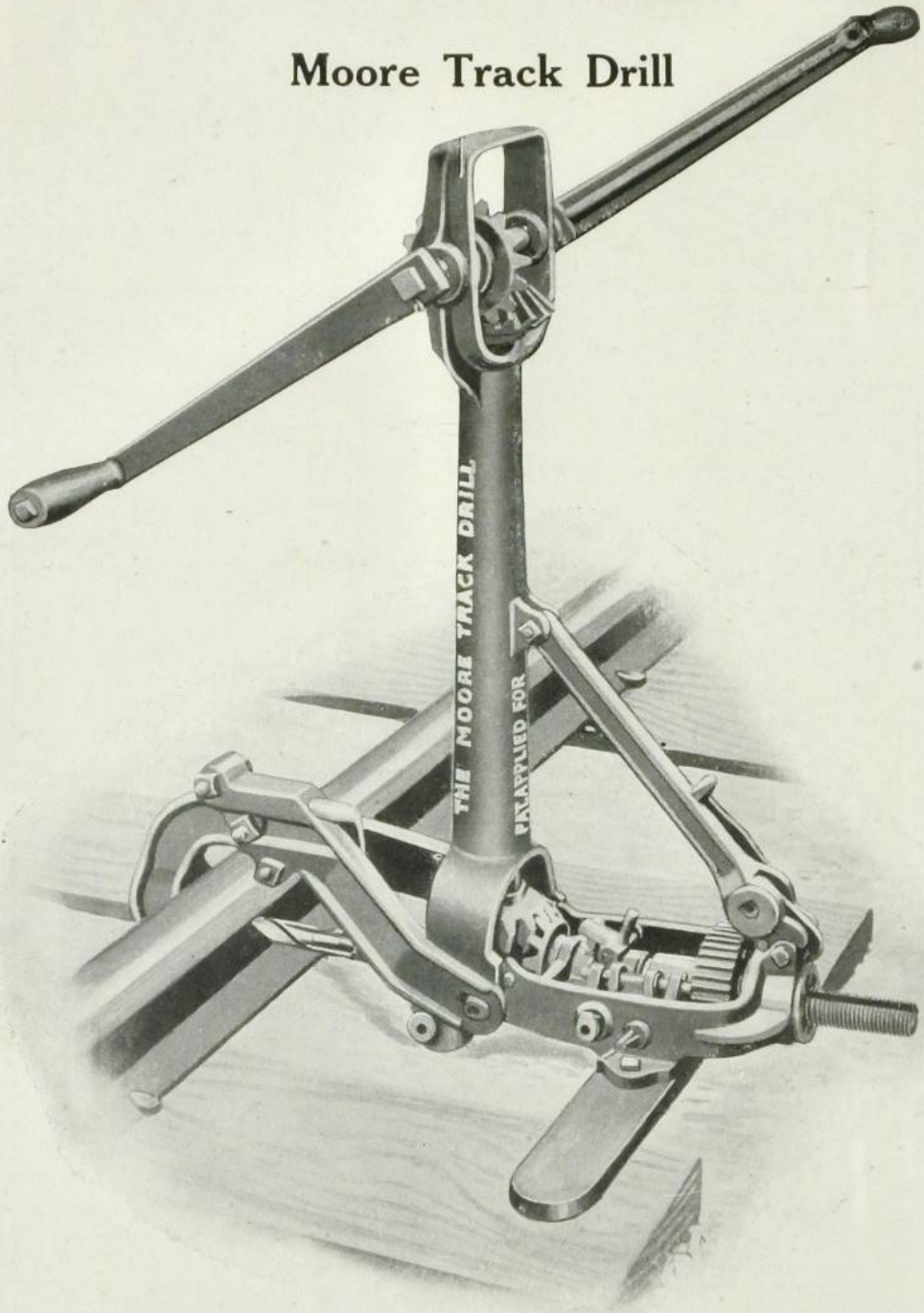


FIG. 1
Showing Over-Clutch or Hook Pattern in Position for Drilling.

The rail hooks may be quickly lengthened for drilling through splice bars, angle bars, frogs, crossings, etc., by removing one bolt. Can be fitted with combination chuck. See description of chuck, pages 26—29.

Moore Track Drill

Nos. 1 and 2

THE MOORE TRACK DRILL is designed for heavy and severe work. It is built along entirely original lines that we know will be greatly appreciated and will meet the most exacting requirements of the Railroads, Contractors, and others. We have no hesitancy in saying that it is superior in every respect to anything that has ever been placed on the market, up to the present time.

The drill is made with a detachable upright or standard (Fig. 1). The upright is quickly erected and rigidly secured to the frame by the shifting of one lever, and is rapidly released by same lever.

The upright and rail hooks can be removed to allow trains to pass (Fig. 5), and quickly replaced, ready to continue drilling, *without disturbing the drill.* It can not become stuck or wedged, so as to prevent removing of the standards, but can be separated instantly.

When separated (Fig. 2), it can be easily carried by one man, one part in each hand, which is not possible with any other track drill, and is arranged compactly for storage or transportation.

The Moore Track drill is adapted for services under any and all conditions, and can be used where other drills can not be used, such as in yards, bridges, tunnels, fills, cuts, etc. In fact, this drill can be used in any place desired.

No. 1 weighs 60 pounds and is designed for drilling holes up to 1¼ inch, and is recommended for section work.

No. 2 weighs 80 pounds, and is recommended for heavy, continuous work in large yards and terminals.

No 3 is an ideal drill for use of section work, and will drill holes up to 1¼ inch, weight, 60 pounds. Any of these drills can be fitted with either the over- or under-clutch, or both, if desired. Either of these drills can be fitted with combination drill bit chuck. See description of chuck, pages 26—29.

Moore Track Drill

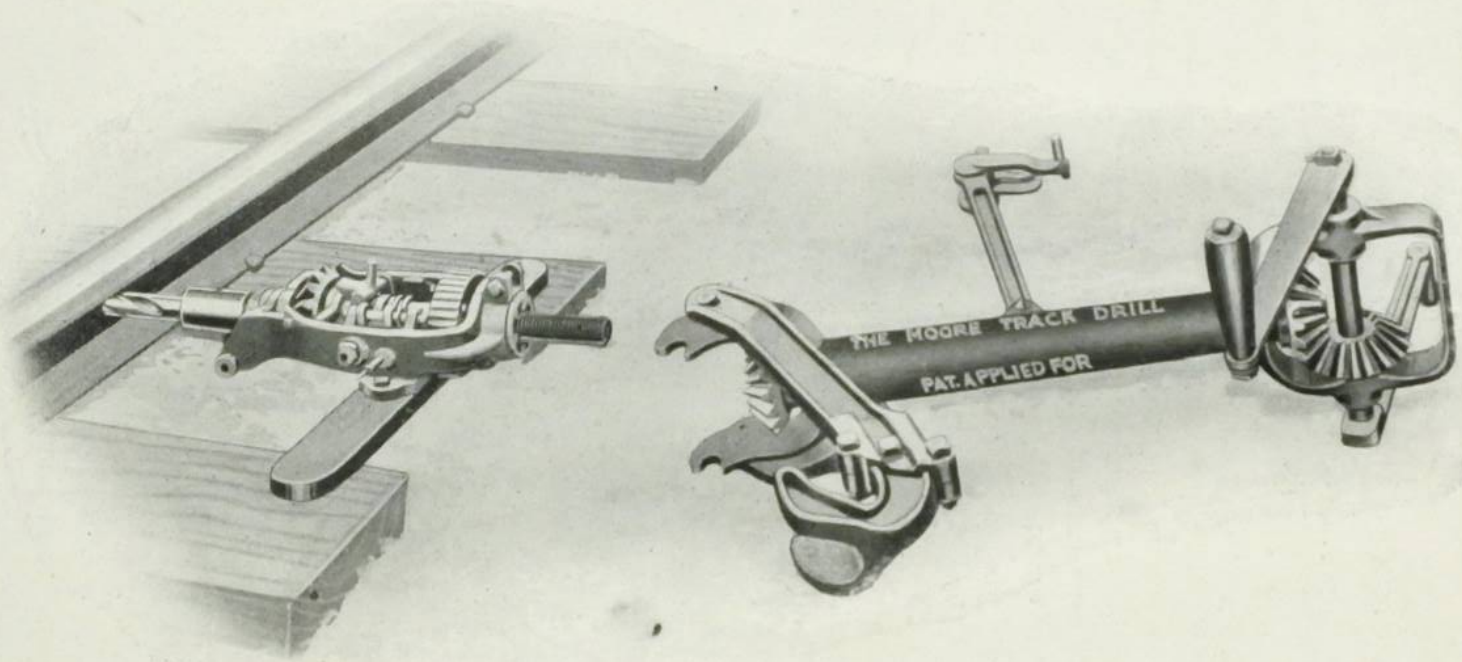


FIG. 2

Showing over-clutch pattern, with upper parts detached for passing trains. This can be done instantly. No delay in detaching or connecting up.

Description of Feed Mechanism

No. 1 and No. 2

THE MOORE TRACK DRILL is equipped with an automatic and variable feed mechanism, which, while a radical departure from others, it is very simple. It has a range of feed from one inch to every 50 revolutions of the spindle to one in every 650. This allows the adjustment of the feed to meet any and all requirements of each piece of work. The feed may be changed while the drill is in operation.

The variable feed is obtained by a friction clutch mechanism (Figs 6, 7 and 8). NN represents the feed dog, which operates in a smooth finished groove in feed nut "O;" by turning in thumb-screw LL, the feed dog NN is given a longer travel, and increases the feed; by turning out thumb-screw LL decreases the travel of the feed dog NN, and reduces the feed as may be desired.

The ordinary track drill has a feed nut that is operated by a ratchet wheel and dog, the points of teeth on the ratchet being sharp soon becomes worn and inoperative, while the Moore Drill has a friction feed, traveling in a smooth finished groove as before mentioned, and at all times kept lubricated and covered with casing ("X," Figs. 6, 7 and 8), making a feed mechanism that will wear and give much more satisfactory results than anything heretofore produced. Every part is freely accessible for repairs, replacements, adjustments, etc.

The feed mechanism is driven by means of a clutch ("N," Figs. 6 and 7), so that it can be connected or disconnected at will. When disconnected and clutch lever "Y" hooked up (as shown in Fig. 6 and by full lines on Fig. 8), the spindle can be rapidly advanced to the rail by turning the crank forward, or withdrawing by reversing the crank. When the drill is advanced to operative position the feed mechanism is thrown into operation by simply unhooking clutch-lever "Y," as shown in Fig. 7 and by dotted lines in Fig. 8. This enables the drill to be quickly applied to the work.

Moore Track Drill Under-Clutch

Can be fitted with combination chuck.
See description of chuck, pages 26—29.

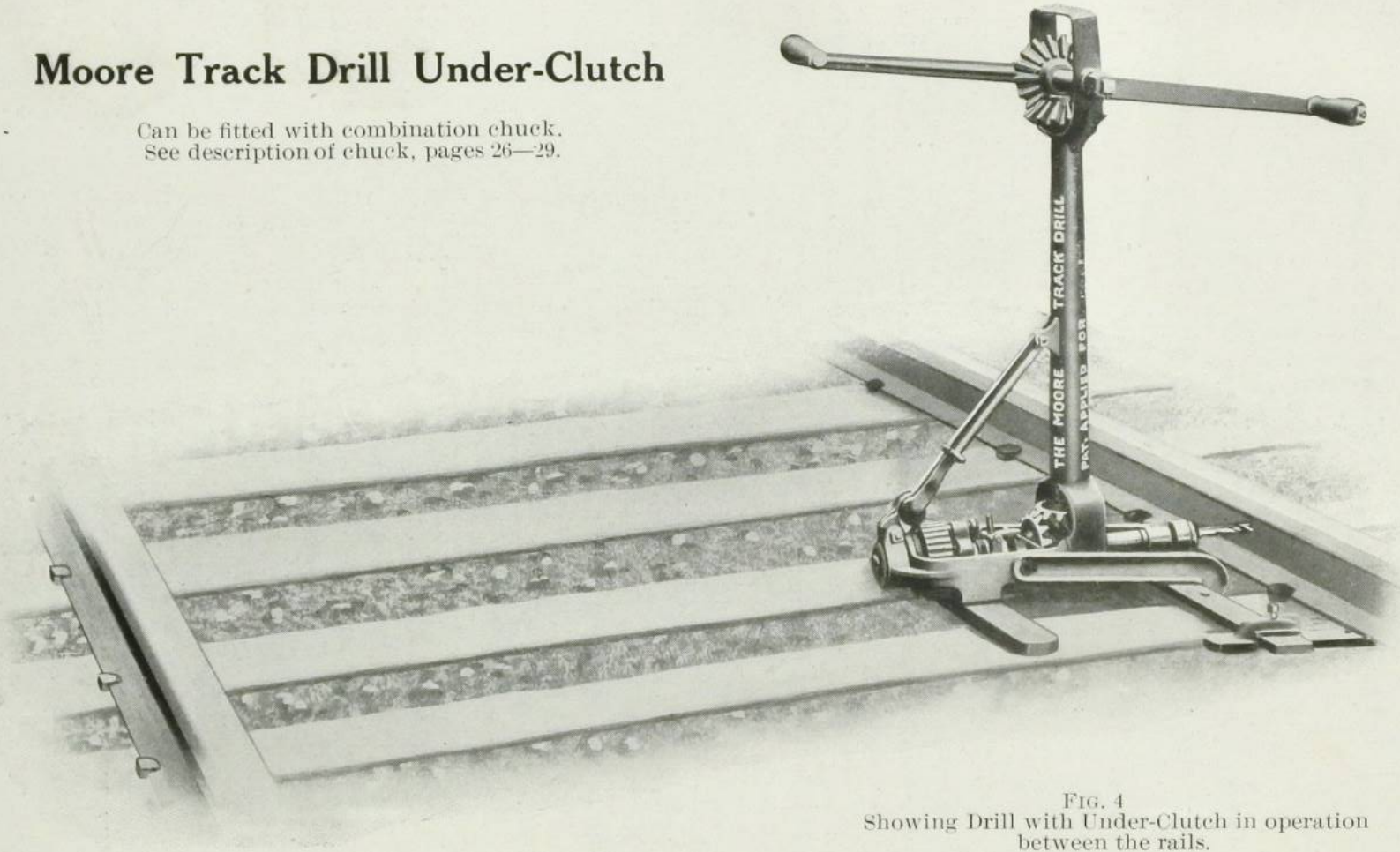


FIG. 4
Showing Drill with Under-Clutch in operation between the rails.

Moore Track Drill

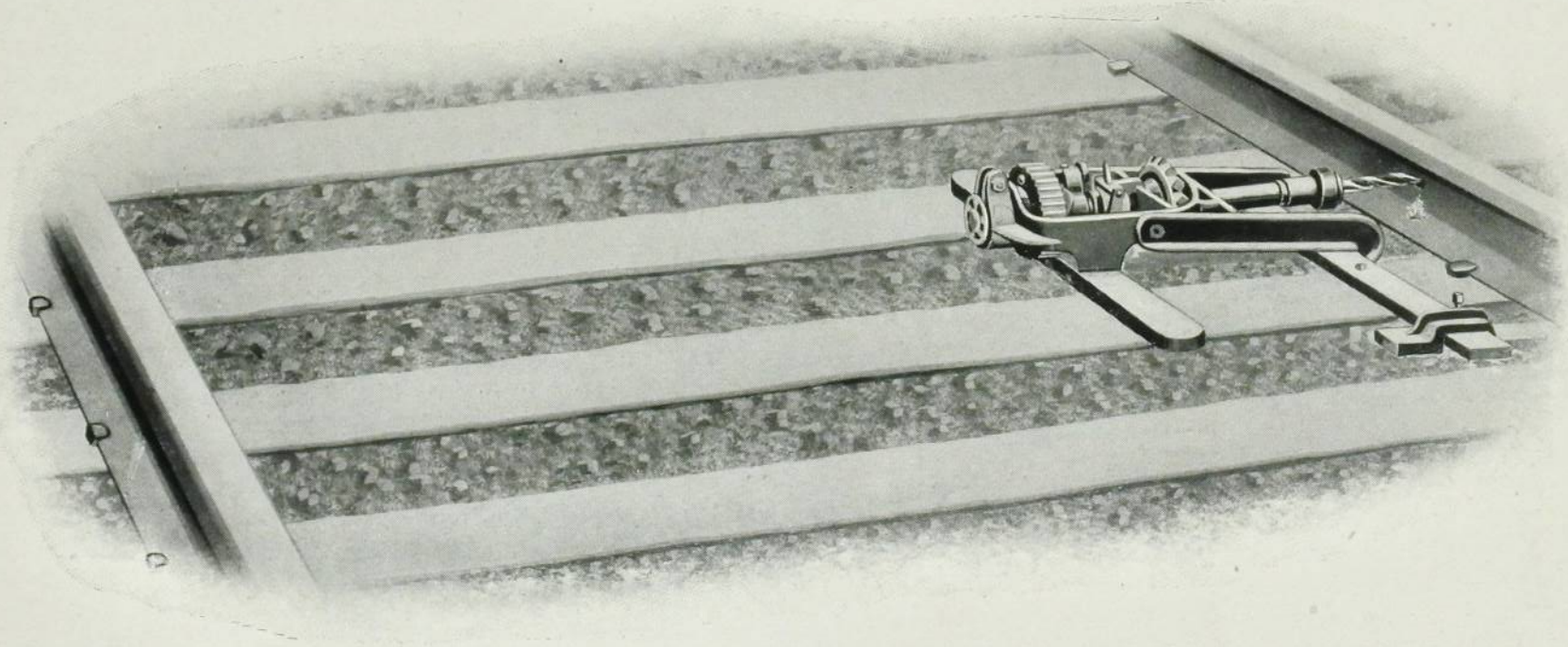


FIG. 5

Showing Drill between the rails with upright detached to allow trains to pass without removing Drill from rail. This is the only Crank Drill on the market at the present time which can be safely used between rails where there are fast moving trains.

Moore Track Drill

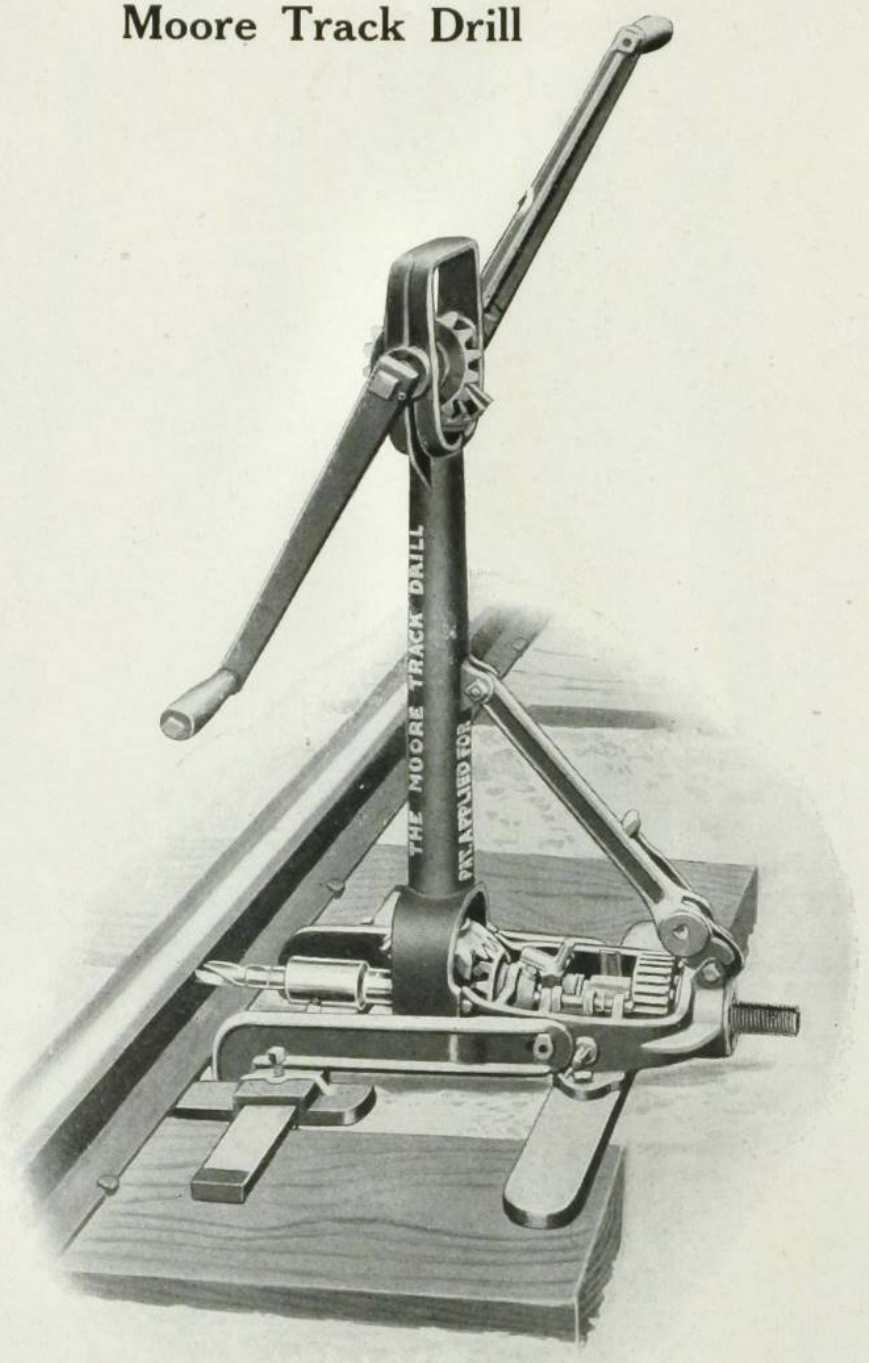
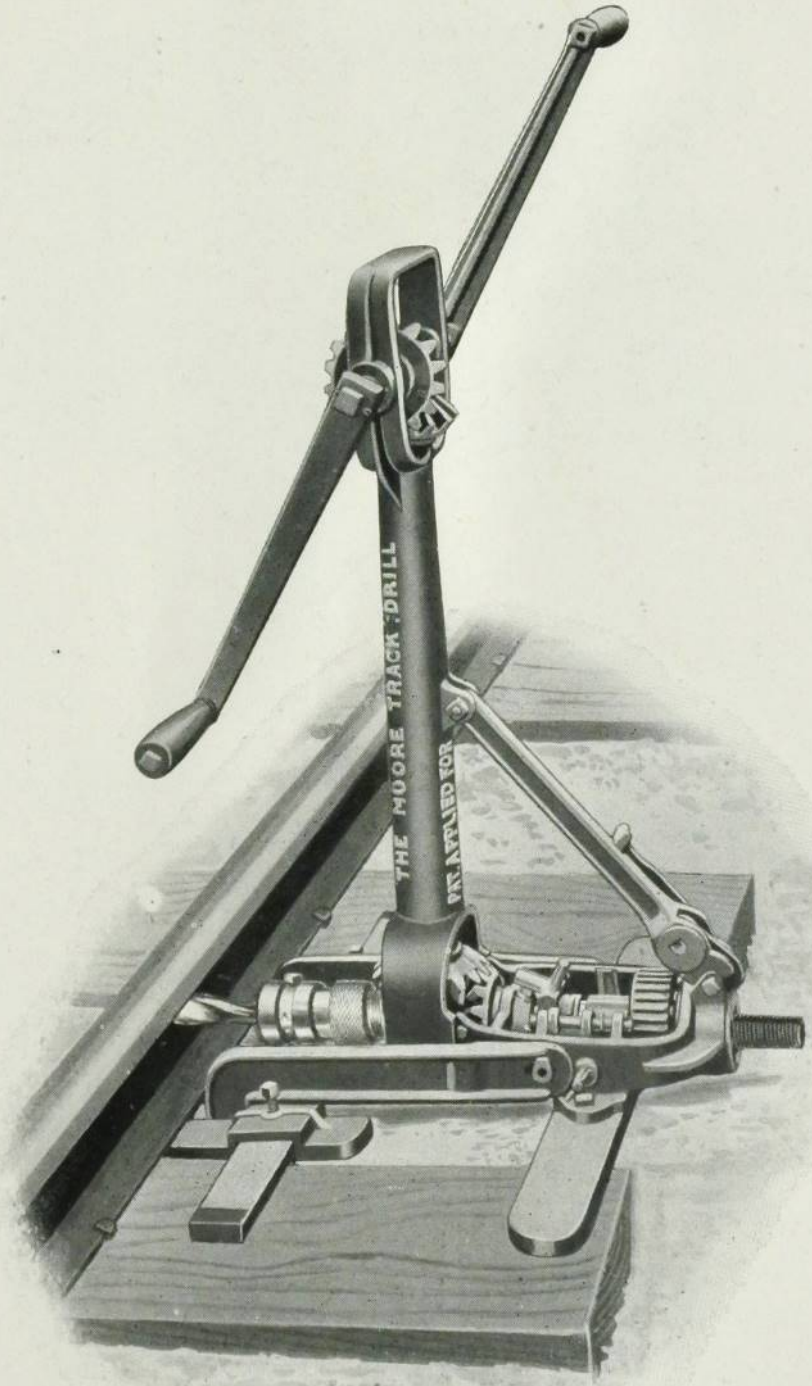


FIG. 3

Showing Under-Clutch Pattern.! This Drill is same as illustrated on preceding pages, except that under-clutch is shown instead of over-clutch. It is detachable, the same as the over-clutch pattern.

Moore Track Drill



With Combination Drill Bit Chuck

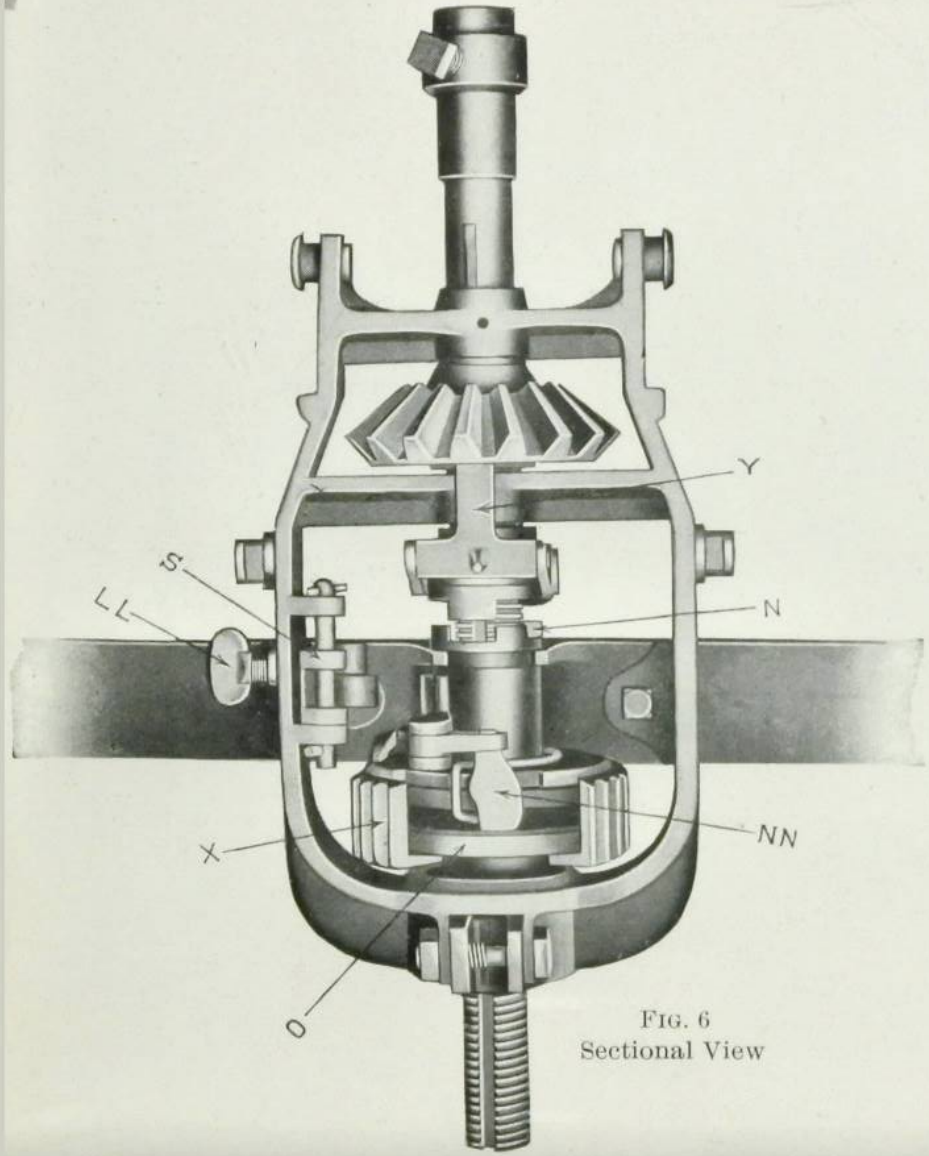


FIG. 6
Sectional View

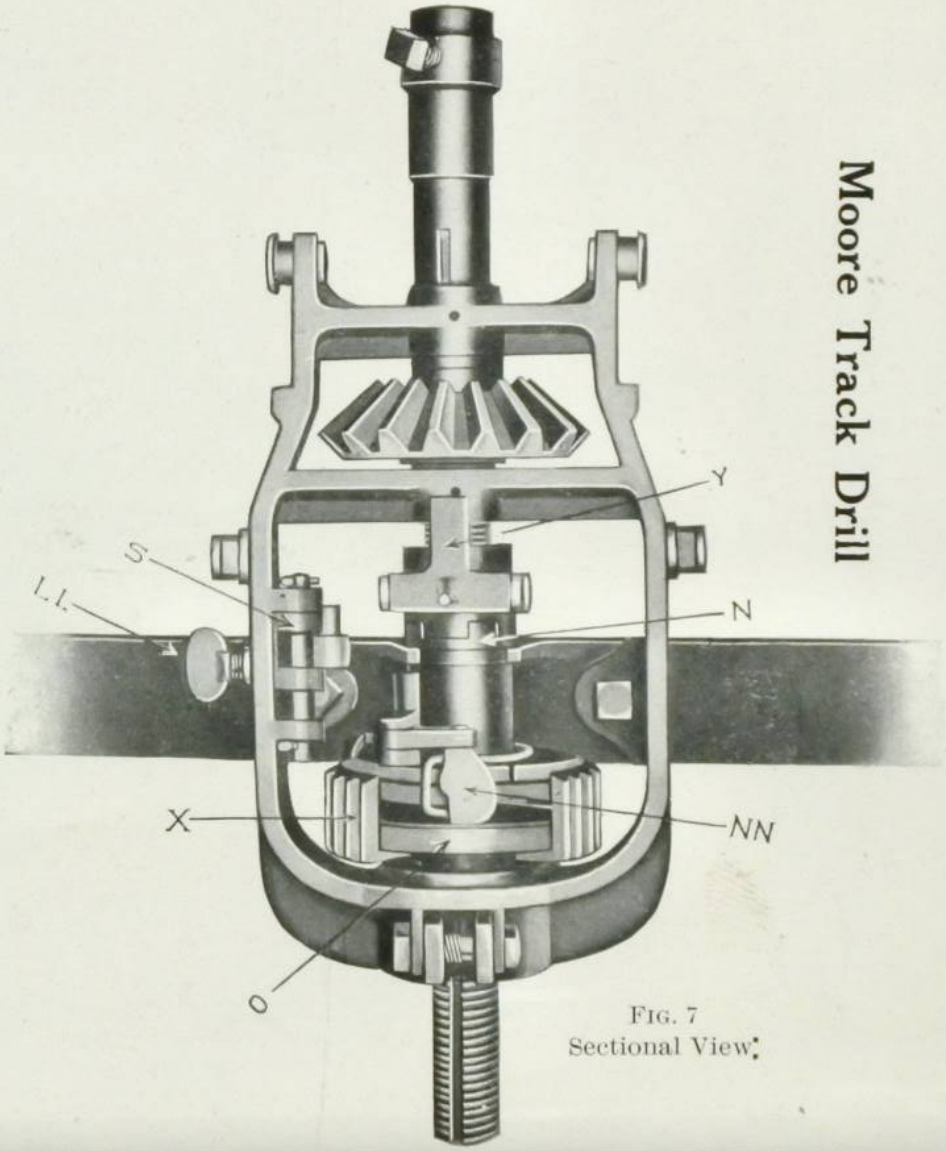


FIG. 7
Sectional View

How to Operate the Moore Track Drill

Over-Clutch Pattern, Fig. 1

1st. Disengage the feed mechanism clutch by throwing the clutch-lever "Y" (Fig. 6) forwardly until it engages the stop lug on the frame, which holds it open. If the drill spindle is in a forward or advance position, it can be quickly withdrawn by turning the cranks backwardly. It is assumed, of course, that the upright or standard has been previously erected.

2d. Place the hook over the rail and then turn the cranks forward, the same as for drilling, until the drill is against the rail in the position desired; then place foot on the feed nut casing "X" (Fig. 6) and turn crank as before until the drill is hard against the rail.

3d. Release the clutch lever "Y" (Fig. 7) and as the clutch is automatically thrown into its engaging position by a spring, the drilling operation may be begun.

4th. To adjust the feed, turn the screw "LL" (Figs. 6 and 7) in to increase, and out to decrease the feed. The scope of this adjustment is such that the operator can secure any desired feed, from one inch for every 50 revolutions to about one inch for every 650, according to the requirements of the particular work in hand.

5th. After a hole is drilled, the clutch lever "Y" is again thrown forward to release the clutch, when the drill may be quickly withdrawn by turning the crank backward. The machine may then be moved for another operation.

Moore Track Drill

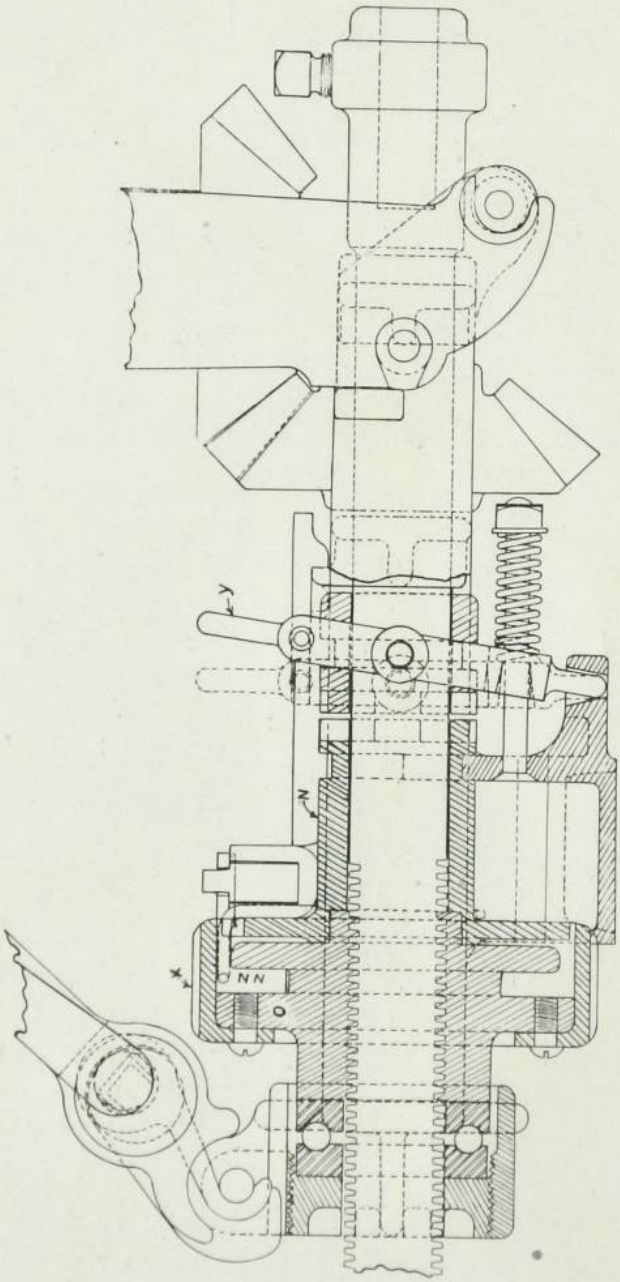
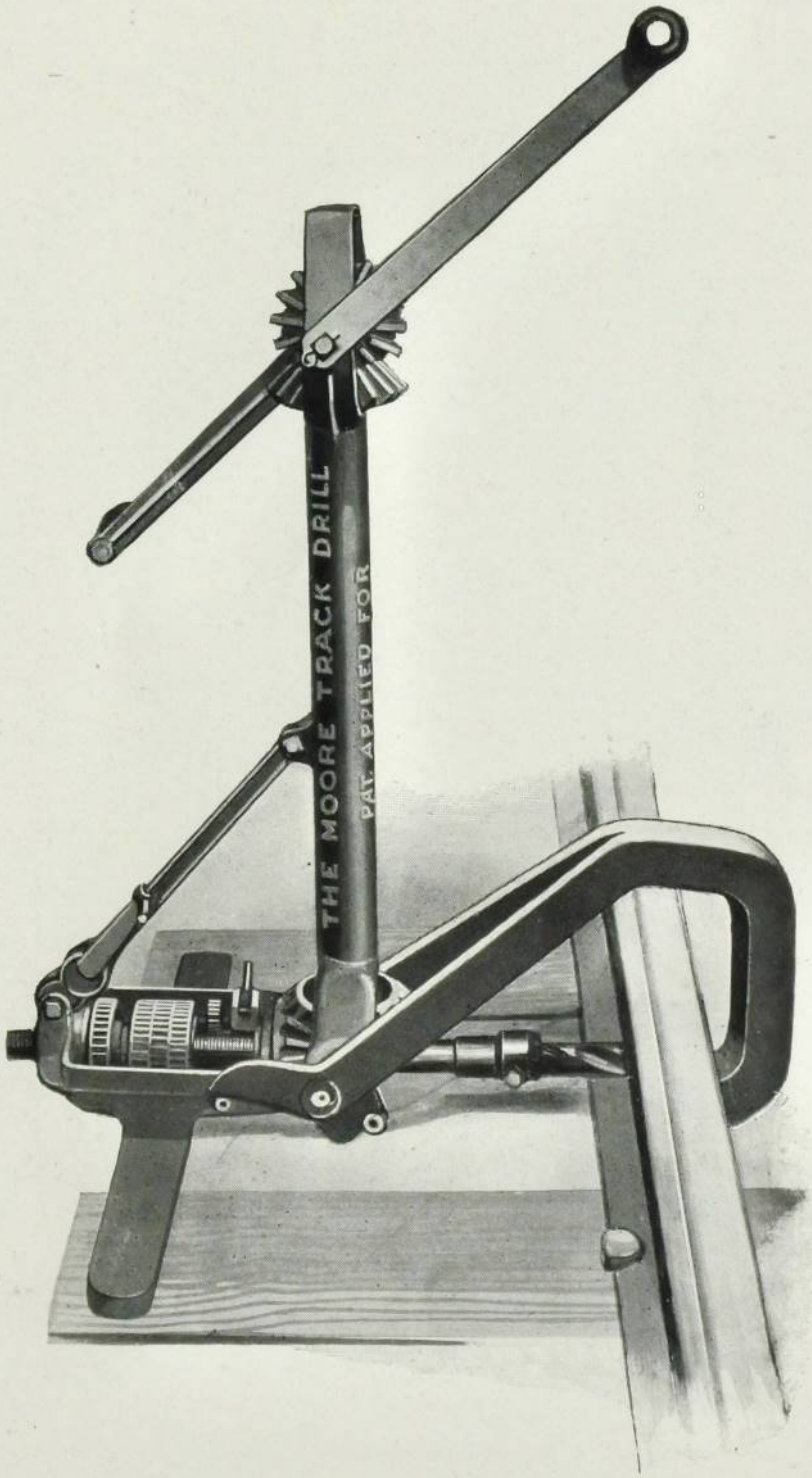


FIG. 8
Sectional View of Feed Mechanism.

BEARINGS—The spindle is provided with a ball thrust bearing (Fig. 8) especially designed for the work, and the other bearings are long and made for durability.

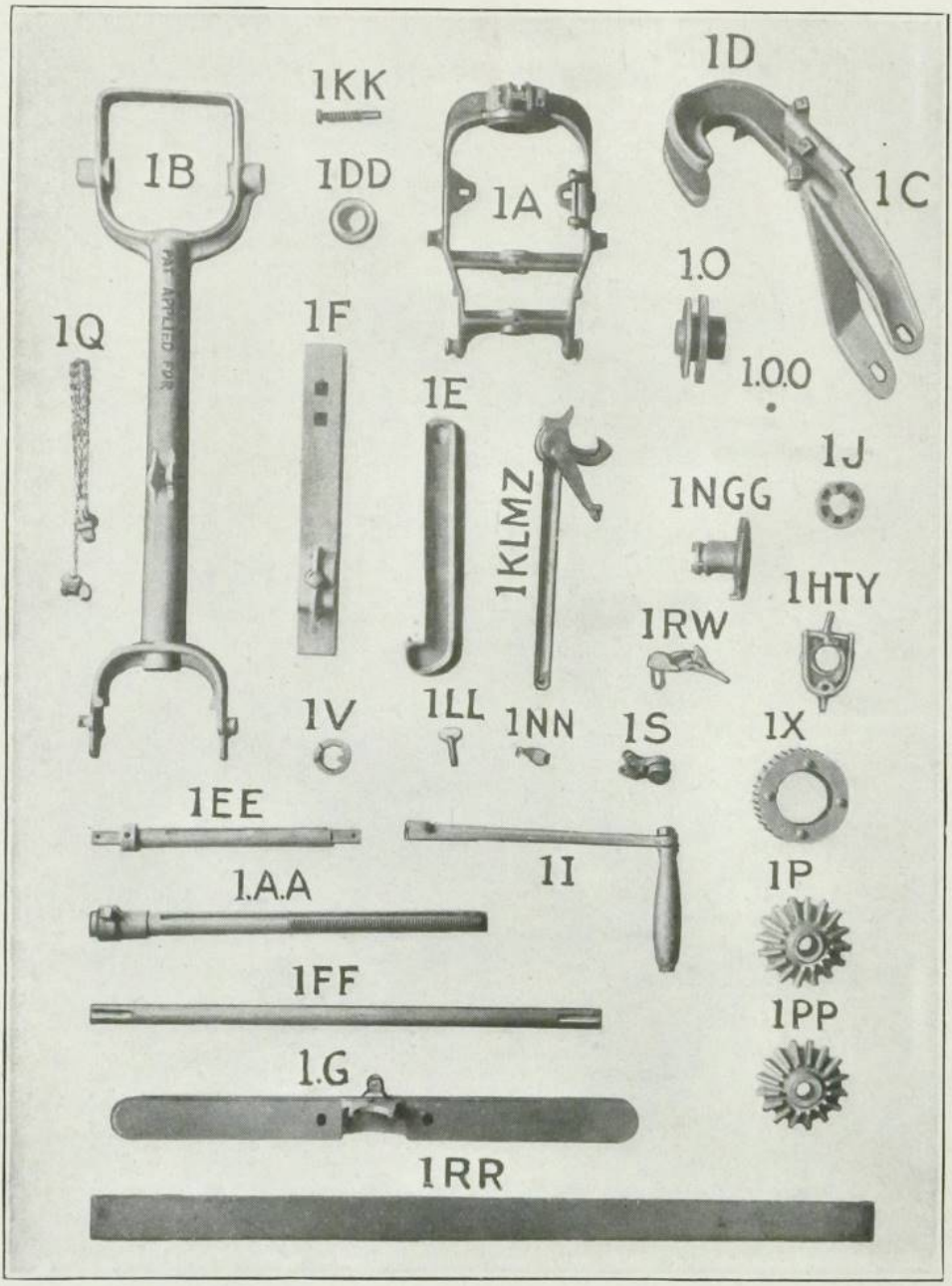
MATERIALS—In the manufacture of the Moore Track Drill we have selected materials which are best adapted to the purpose, and, like the workmanship, first-class and above criticism.

Moore Special Track Drill



For Girder Rails and I Beams

Repair Parts for Moore Track Drill No. 1



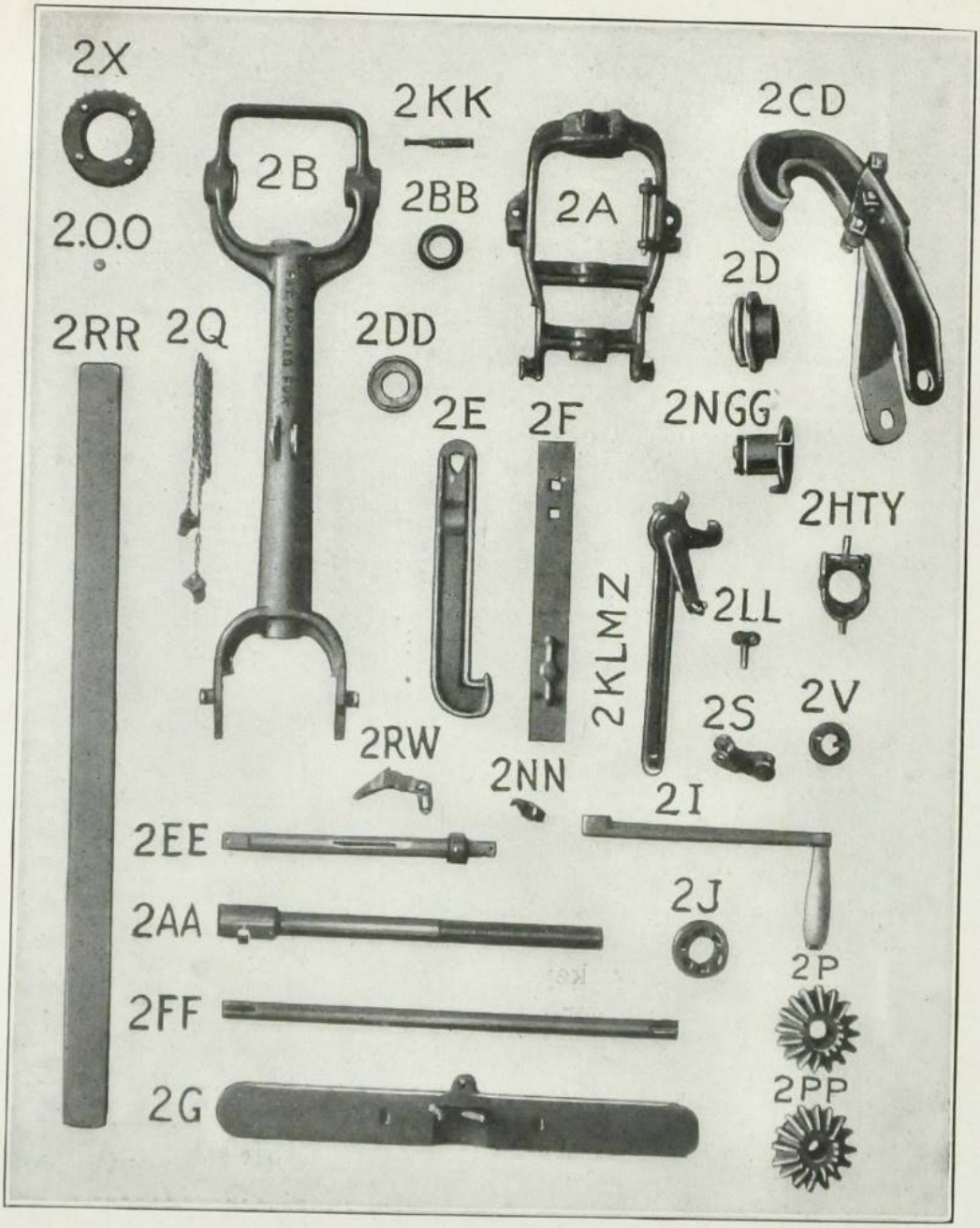
Prices on opposite page.

Price List Moore Track Drill No. 1

June 10, 1907

		Price
1A	Base with feed bracket pin and bolt	$2 50
1B	Upright frame	3 00
1C	Rail hook arm, R. and L. (2 per set)	80
1D	Rail hook for standard rail	60
1D1	Rail hook for guard rail	75
1E	Underclutch hook, R. and L.	50
1F	Underclutch eye bar (two per set)	1 40
1G	Foot plate	50
1HTY	Shifting lever, complete	1 25
1I	Crank with wood handle and bolt (two per set)	1 00
1J	Ball bearing adjusting nut	1 00
1KLMZ	Back brace complete	1 25
1NGG	Clutch flange and spring	1 10
1O	Feed nut	1 25
1P	Gear for spindle with key 1 1-16-inch bore	50
1Q	Underclutch lugs with chain	30
1RW	Feed lever with link and pin	50
1S	Feed bracket with roll and stud	30
1V	Clutch collar and key	50
1X	Feed nut case	75
1AA	Spindle with set screw	2 50
1DD	Ball bearing race (two per set)	1 00
1EE	Crank shaft with collar	75
1FF	Vertical shaft, keyseated	1 00
1KK	Clutch collar spring and bolt	15
1LL	Feed adjusting screw	25
1NN	Feed dog	25
1OO	5-16-inch steel ball (16 per set)	50
1PP	Gear, ⅞-inch bore, keyseated (three per set)	1 50
1RR	Underclutch cross bar, steel	60
1GG	Feed dog spring	10

Repair Parts for Moore Track Drill No. 2



Prices on opposite page.

Price List Moore Track Drill No. 2

June 18, 1907

		Price
2A	Base with feed bracket pin and bolt	$4 00
2B	Upright frame	5 00
2C	Rail hook arm, R. and L.	2 35
2D	Rail hook for standard rail	95
2D2	Rail hook for guard rail	1 00
2E	Underclutch hook, R. and L.	80
2F	Underclutch eye bar (two per set)	2 00
2G	Foot plate	90
2HTY	Shifting lever complete	2 25
2I	Crank with wood handle and bolt (two per set)	1 80
2J	Ball bearing adjusting nut	1 00
2KLMZ	Back brace complete	2 00
2NGG	Clutch flange and spring	1 90
2O	Feed nut	2 25
2P	Gear for spindle with key, 1¼-inch bore	75
2Q	Underclutch lugs with chain	50
2RW	Feed lever with link and pin	90
2S	Feed bracket with roll and stud	55
2V	Clutch collar with key	90
2X	Feed nut case	1 30
2AA	Spindle with set screw	4 00
2BB	Ball bearing cone	75
2DD	Ball bearing cup	75
2EE	Crank shaft with collar	1 20
2FF	Vertical shaft, keyseated	1 50
2KK	Clutch spring with bolt	15
2LL	Feed adjusting screw	25
2NN	Feed dog	25
2OO	⅝-inch steel ball (16 per set)	50
2PP	Gear, 1-inch bore, keyseated (three per set)	2 25
2RR	Underclutch cross bar, steel	90
2GG	Feed dog spring	10

Moore No. 3 Gear Feed Track Drill

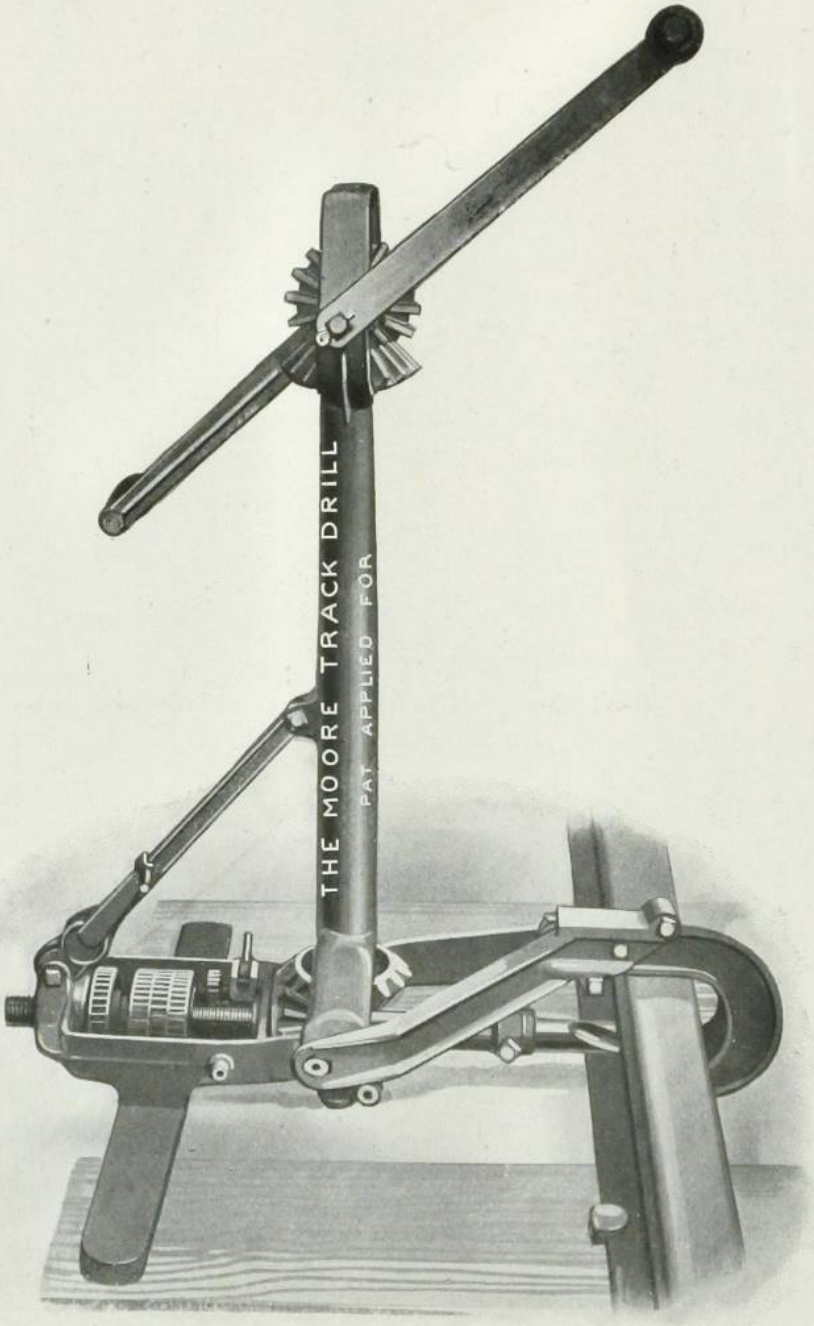


FIG. 9

Showing Over-Clutch Pattern in position for drilling.

Moore No. 3 Gear Feed Drill

IN offering the No. 3 Moore Track Drill, we desire to call your particular attention to its extreme simplicity, and small number of working parts. It has been designed to meet the demands of some railway men for a simpler drill, to be used when there are fewer sizes of holes to be drilled, and the hardness of the rails are more uniform. In such cases it is not necessary to have as wide a range of feed as represented in No. 1 and No. 2 Drills.

The feed mechanism is all plain gearing, exposed to the view of the operator at all times, and he knows absolutely what feed he is using, and just how many turns of the crank necessary to advance the drill bit one inch.

There are three changes of the feed, as follows :

The slow feed (H1, Fig. 12) requires 360 turns of the crank to advance the drill bit one inch.

The medium feed (H2, Fig. 12) requires 180 turns of the crank to advance the drill bit one inch.

The fast feed (H3, Fig. 12) requires 120 turns of the crank to advance the drill bit one inch.

One man can operate drill when drilling holes from $\frac{5}{8}$-inch to $\frac{7}{8}$-inch. Two men when drilling holes from 1 inch to $1\frac{1}{4}$ inch.

The drill is very compact and strong, and has the same detachable rail hook and upright as the No. 1 and No. 2, and can be furnished with either the over- or under-clutch, as may be desired.

This drill can be equipped with our combination drill bit chuck. See description of chuck on pages 26—29.

Made in one size and weight, about 60 pounds.

Moore No. 3 Gear Feed Track Drill

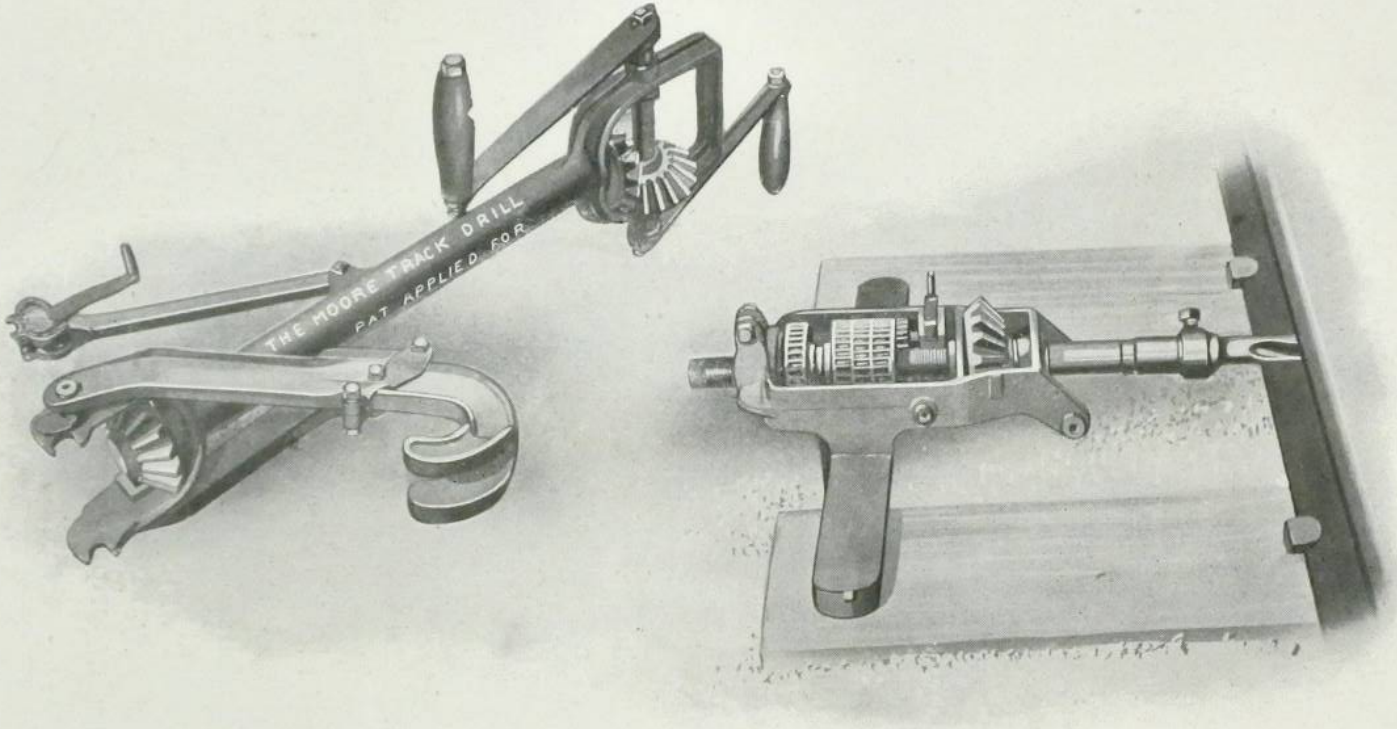
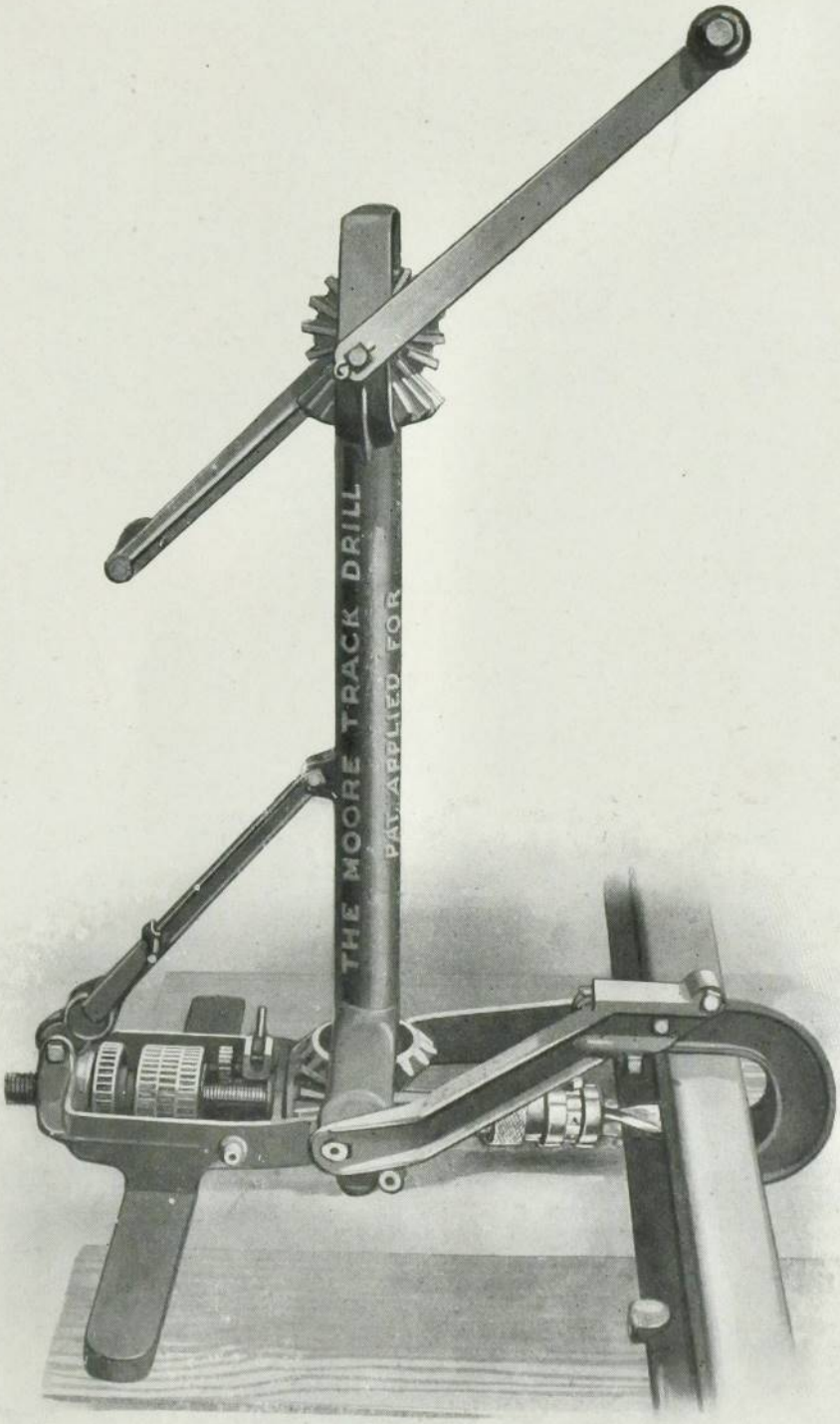


FIG. 10
Showing Over-Clutch Pattern with upper parts detached for passing trains. This can be done instantly. No delay in taking off or replacing.

Moore No. 3 Gear Feed Track Drill



With Combination Chuck

Moore No. 3
Gear Feed
Track Drill

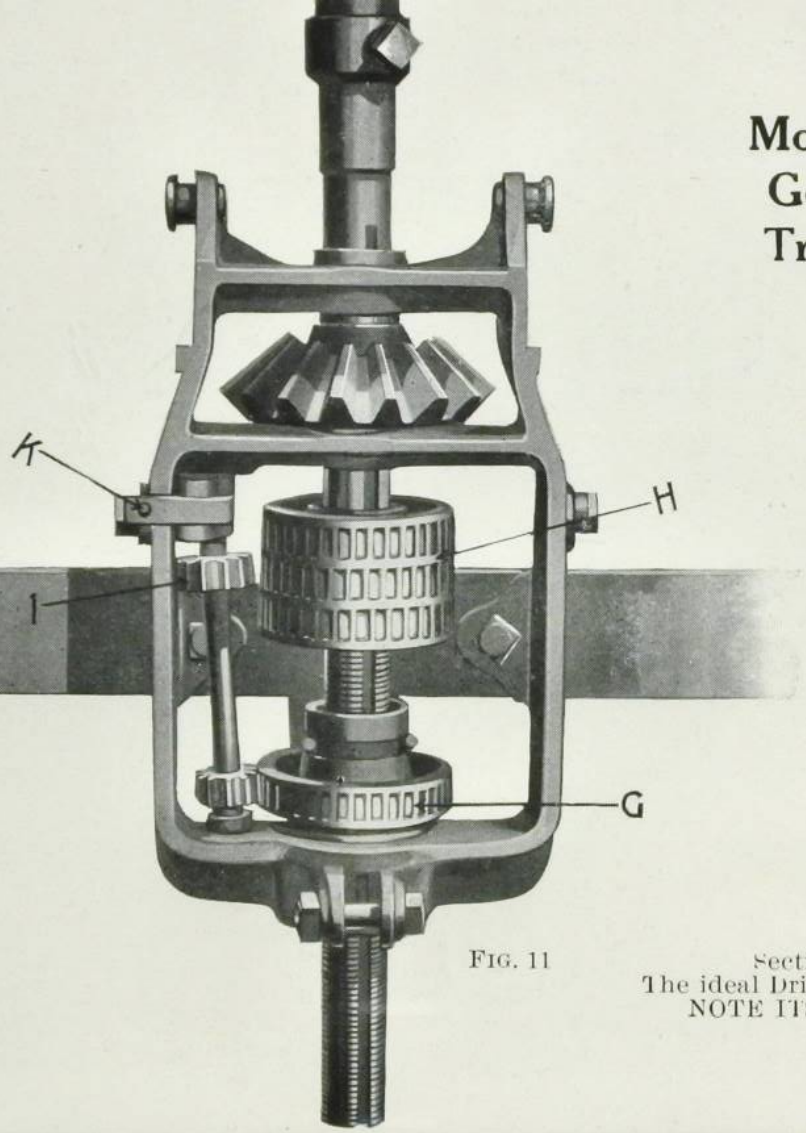


FIG. 11

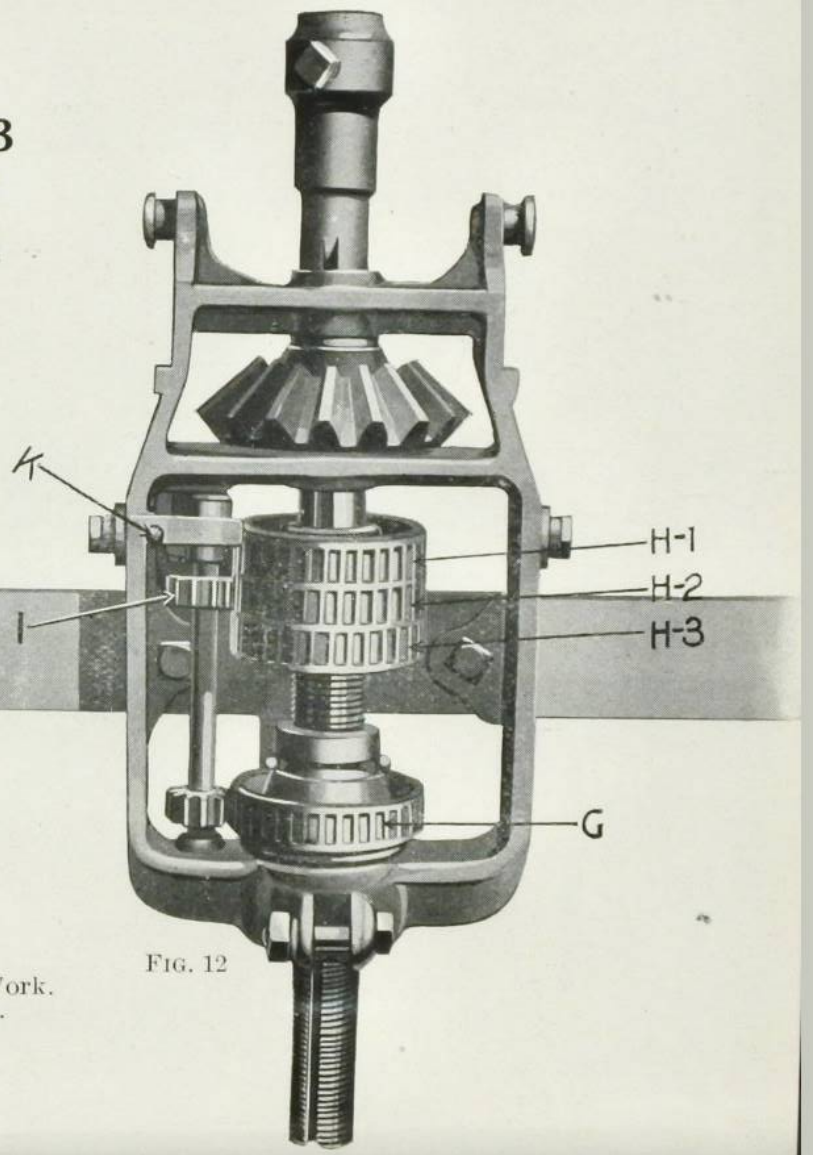


FIG. 12

Sectional View.
The ideal Drill for Section Work.
NOTE ITS SIMPLICITY.

HOW TO OPERATE

Moore No. 3 "Gear Feed" Track Drill

See Fig. 11, showing the small gear "I" thrown out of mesh with gear "H." In this position the spindle can be quickly advanced to or returned from the work. After the drill bit is snug against the rail, unhook lever "K" and place small gear "I" in mesh with "H-1," "H-2" or "H-3," as desired (Fig. 12).

Gear "H-1" is the slow feed and has 35 teeth.

Gear "H-2" is the medium feed and has 34 teeth.

Gear "H-3" is the fast feed and has 33 teeth.

The feed-nut, (with gear "G") has 10 "Acme" threads to the inch and the gear has 36 teeth.

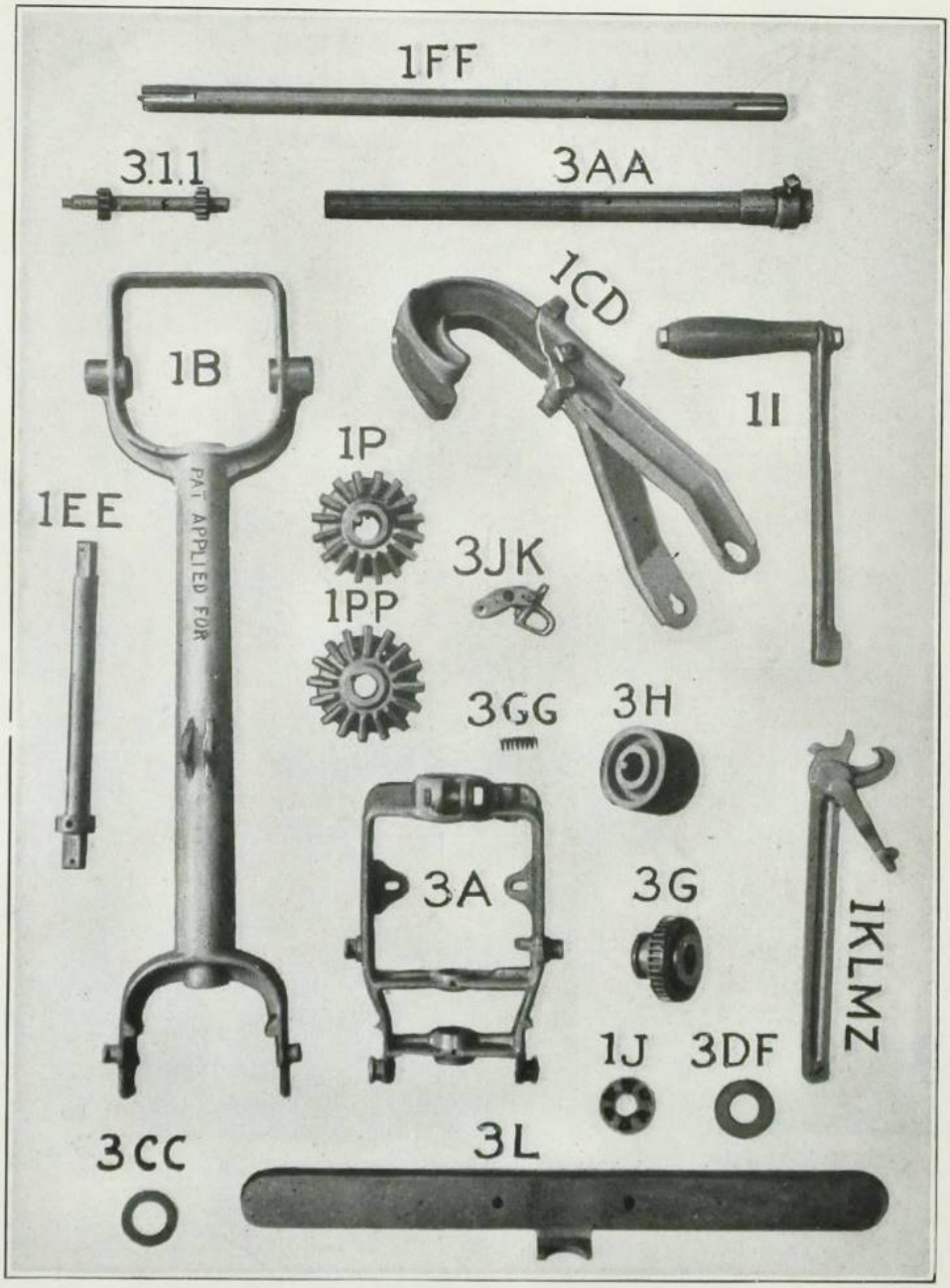
The intermediate shaft bears two gears (one marked "I" in Figs. 11 and 12) each having 12 teeth, cut from solid steel blanks. This shaft and gears connect the feed nut "G" with the change-feed gear "H"

Gear "I" is operated and held in or out of mesh with change-feed gear "H," by lever "K."

We invite tests under severest conditions, and comparison of our drills with others. And we solicit orders with the distinct understanding that if the Moore Track Drills will not do all that we claim for them, they can be held subject to our order, or returned at our expense.

TRY THEM! TEST THEM!

Repair Parts for Moore Track Drill No. 3



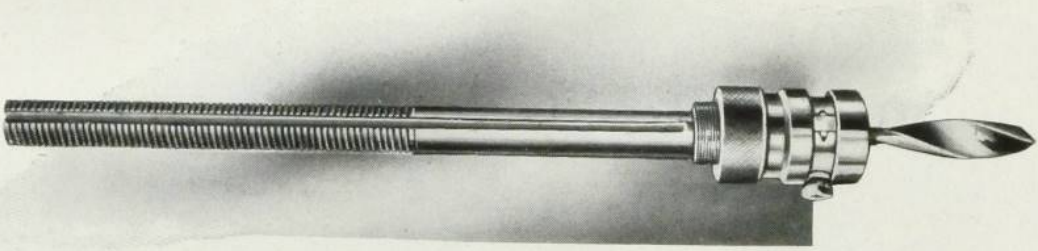
Prices on opposite page.

Price List Moore Track Drill No. 3

June 18, 1907

		Price
3A	Base with bolt	$2 50
1B	Upright frame	3 00
1C	Rail hook arm, R and L	80
1D	Rail hook	60
3DF	Friction Washer	15
3G	Feed nut, 36 teeth	1 25
3H	Assembled 33, 34 and 35-tooth gear	2 25
1I	Crank with wood handle and bolt (two per set)	1 00
1J	Ball-bearing adjusting nut	1 00
3JK	Shifting gear bracket and lever	75
1KLMZ	Back brace complete	1 25
3L	Foot plate	50
1P	Gear for spindle with key 1 1-16-inch bore	50
3AA	Spindle with set screw	2 50
3CC	Fiber Washer	10
1EE	Crank shaft with collar	75
1FF	Vertical shaft, keyseated	1 00
3GG	Feed dog spring	10
3II	Gear shaft, 12 teeth on each end	1 00
1PP	Gear, ⅞-inch bore, keyseated (three per set)	1 50

Moore Combination Drill Bit Chuck



The Drill Bit Chuck shown with spindle in above cut, is so simple in its construction that it is hardly necessary to describe it. However, we would call your attention to at least one of its very commendable features, and that is, it will take bars of commercial sizes, so that the users are not compelled to buy specially rolled steel to make their drill bits, but can buy anywhere.

This Spindle, with chuck, can be furnished for any of drills Nos. 1, 2 or 3 now in service.

Moore Combination Drill Bit Chuck

OWING to the demand for drill bits made of air hardened, or what is known as high speed steel—and a chuck to hold said drill bits—the Moore Drill Bit Chuck has been designed for that purpose.

This being a combination chuck, it can be used for either the high speed steel flat bit or the standard round shank drill bit now in use. This is a great advantage to the users, as it enables them to use drill bits taken from stock

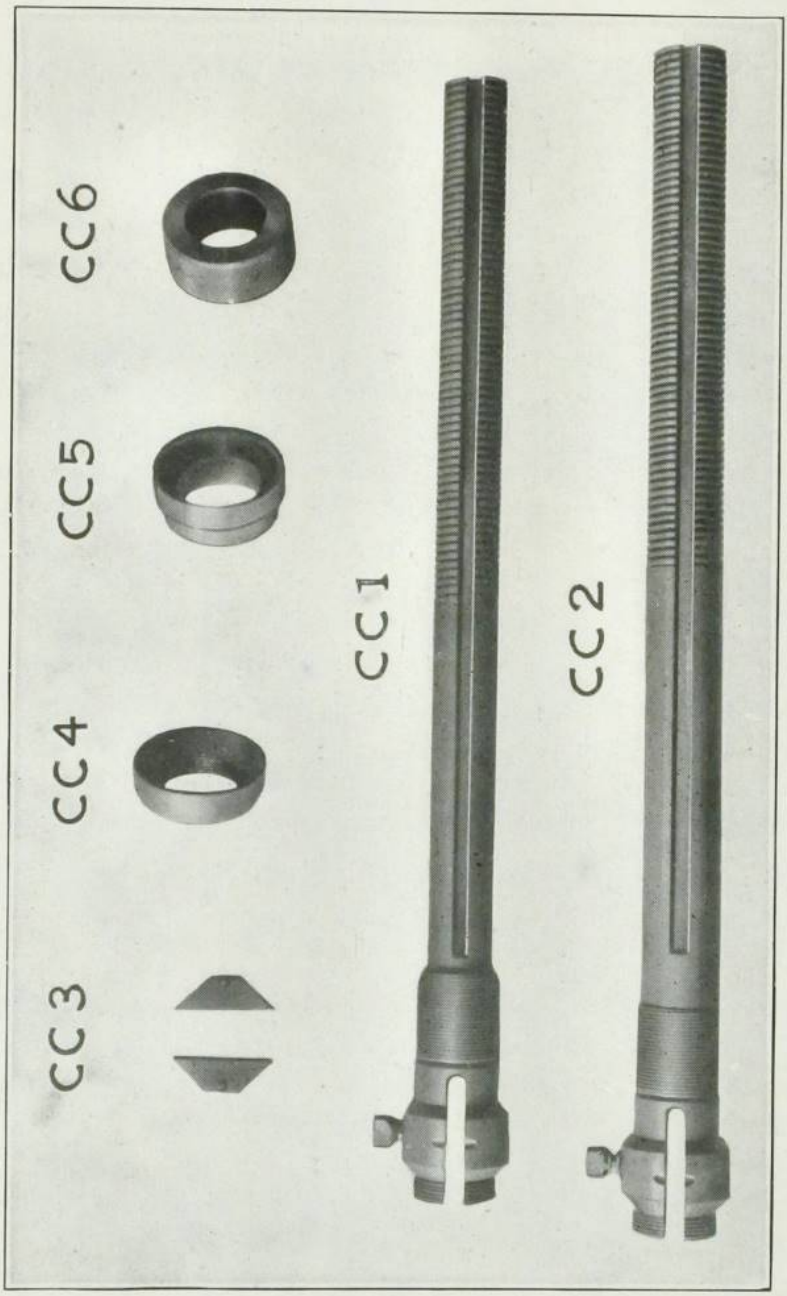
You will see from the illustration that it is very simple in its construction, there being only five parts; in fact, it is so simple in its construction that it hardly needs further description. However, we would call your special attention to the fact that the drill bit is driven by the spindle direct. The outer sleeve and jaws being used only to center bit, hence there is no wear on these parts, and they cannot get out of order at any time.

These chucks with spindles can be fitted to any of our drills now in use.

A Word About High Speed Steel Drill Bits

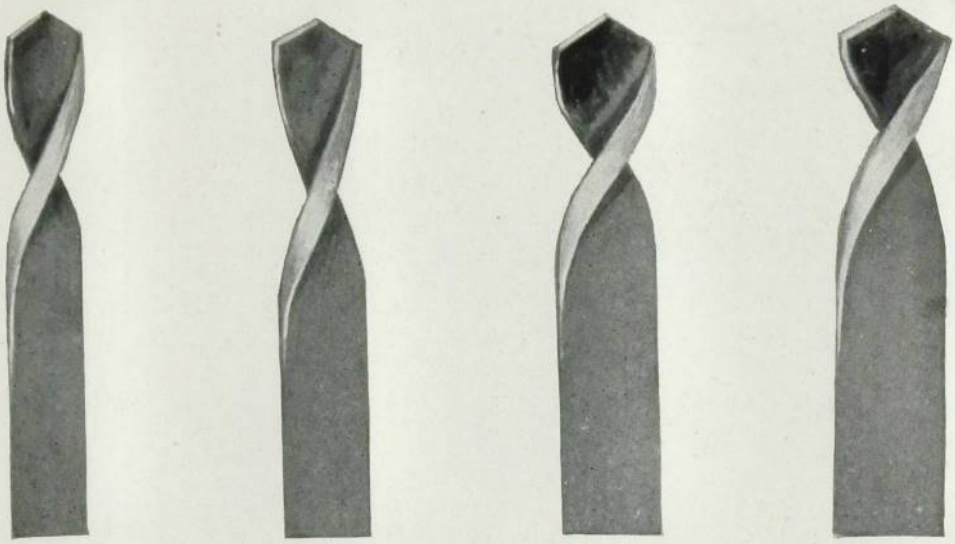
We have made several tests, with the various brands of air hardened, or what is known as high speed steel, and all of them have proved a great advantage to us over the best brands of tool steel that we could find on the market. For instance, we made several bits from the high speed steel, and all of them drilled into the head of a steel rail from 100 to 200 holes one inch deep, without having to sharpen the drill bit. All of the holes we drilled without using any lubricant. One bit we drilled 176 holes one inch deep in the head of a rail and the drill bit seemed to cut as free on the 176th hole as it did on the first.

Repair Parts for Combination Drill Bit Chuck



		NET
CC1	Spindle for No. 1 Drill	$2 50
CC2	Spindle for No. 2 Drill	2 75
CC3	Jaws (2) for No. 1 and No. 2 Spindle	75
CC4	Outside Collar for No. 1 and No. 2. Spindle	50
CC5	Inside Collar for No. 1 and No. 2 Spindle	50
CC6	Milled Nut for Adjustment	75
	Spring for Jaws	20

High Speed Steel Drill Bits



The above drill bits fit the Moore Combination Drill Chuck, and are made from merchant bar sizes, thus avoiding the necessity of having a special rolled steel.

$\frac{5}{8}$ inch	$ 95	1 inch	$1 40
$\frac{3}{4}$ "	1 05	$1\frac{1}{16}$ "	1 50
$\frac{13}{16}$ "	1 15	$1\frac{1}{8}$ "	1 60
$\frac{7}{8}$ "	1 20	$1\frac{3}{16}$ "	1 70
$\frac{15}{16}$ "	1 30	$1\frac{1}{4}$ "	1 85

Moore No. 5
Bonding Drill

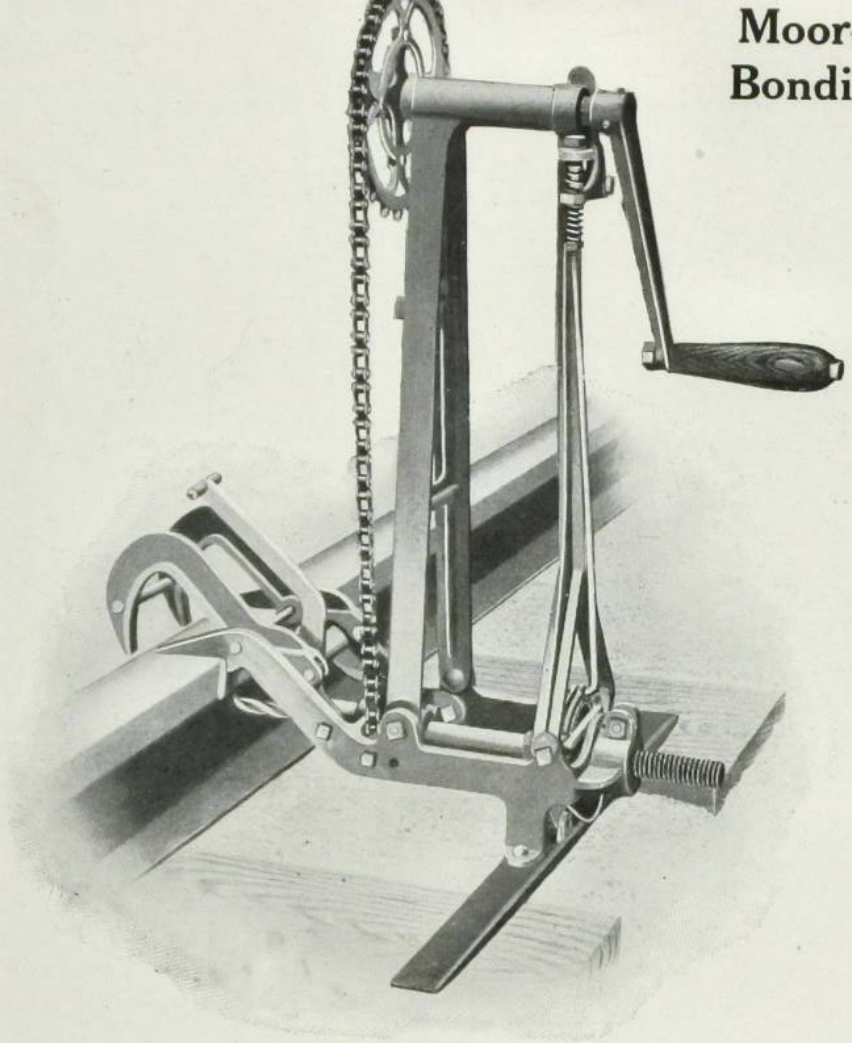


FIG. 13

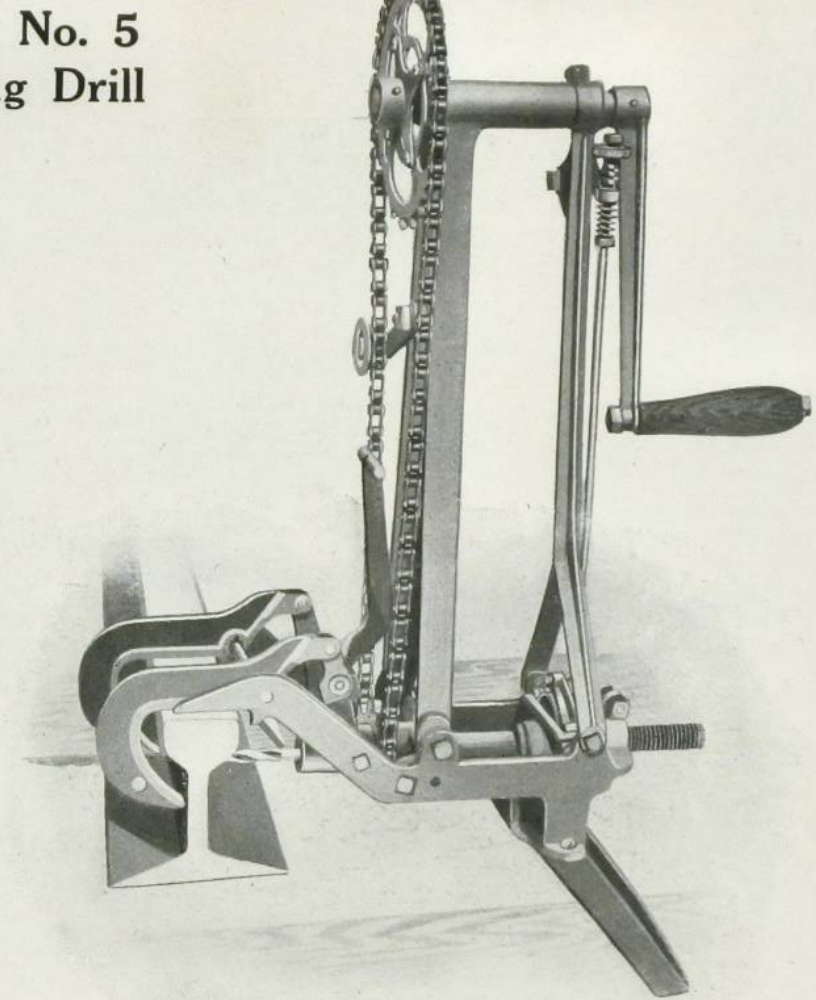


FIG. 14

A TRIAL WILL CONVINCE YOU THAT THIS IS THE DRILL

Moore No. 5 Bonding Drill

THE MOORE NO. 5 BONDING DRILL, as illustrated on the following pages, is especially designed for the use on railroads using track circuit and where it is necessary to drill holes for the bond wires 9-32-inch, this being the bond used by the different signal companies. This drill has many features far superior to anything heretofore designed for the purpose. It is very compact and simple, there being only a few working parts. It is light, yet durable, and is fitted with ball thrust bearing on spindle. All parts are made of material especially selected and which is best adapted to the purpose, so as to get the best results, and, like the workmanship, is above criticism. We invite trials and tests as to its efficiency and durability.

As already noted, 9-32-inch bonds is the size generally used by the railroads using track circuit, but where a smaller or larger bond is used the chuck can be arranged to suit.

Fig. 13 shows drill on rail with hooks raised, ready to attach for drilling.

Fig. 14 shows drill with hooks thrown down, engaging rail ready for operation.

This drill weighs 25 pounds, and is designed for drilling holes for 9-32-inch bonds.

One high speed steel drill bit is furnished with every drill. Price, $25.00.

No. 5 Moore Drill

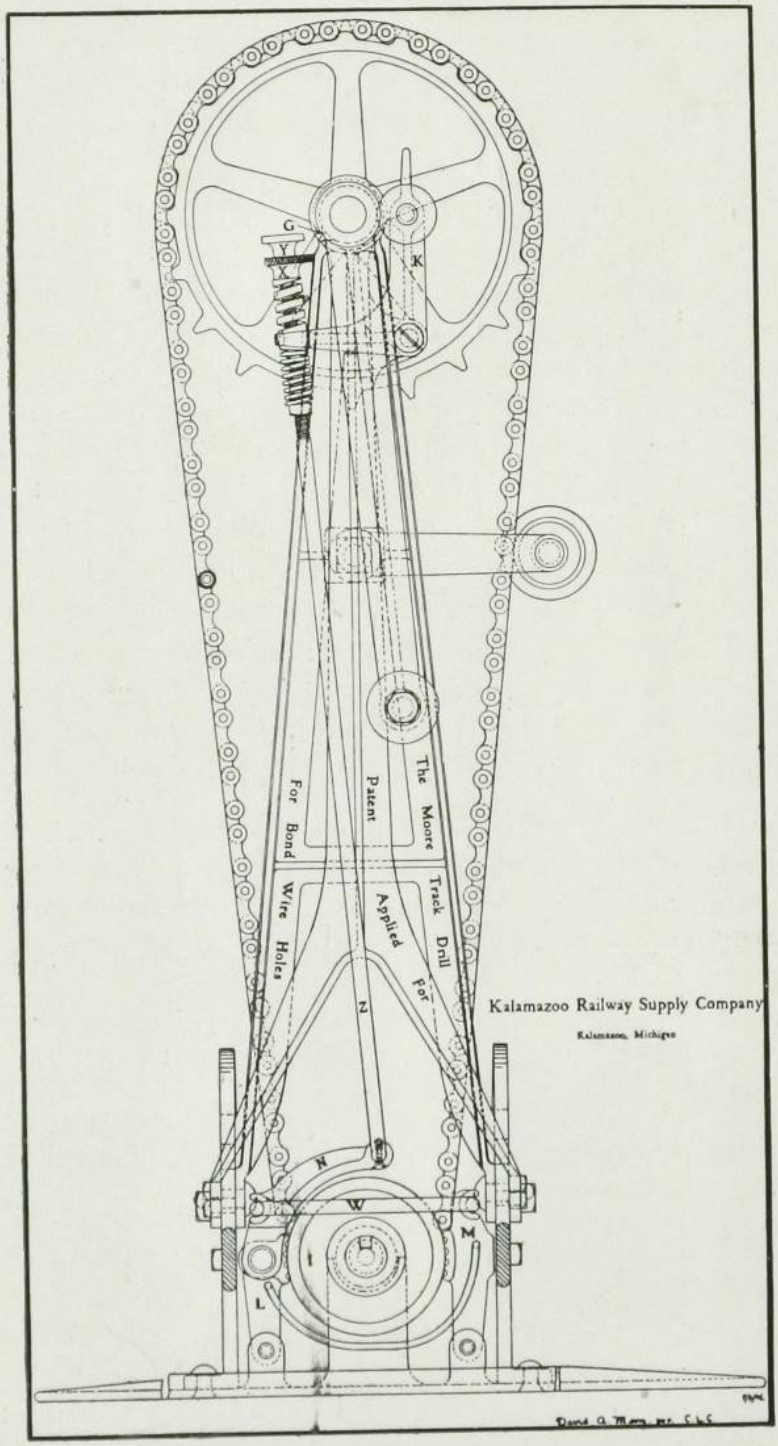


FIG. 15
Sectional elevation showing feed and quick advance and return mechanism for spindle.

How to Operate

To advance the drill bit to the rail, press thumb against lever "K" (Fig. 15), which grips the feed nut, and turn the crank ahead the same as for drilling, which brings the bit against the rail with any pressure that may be desired by the operator.

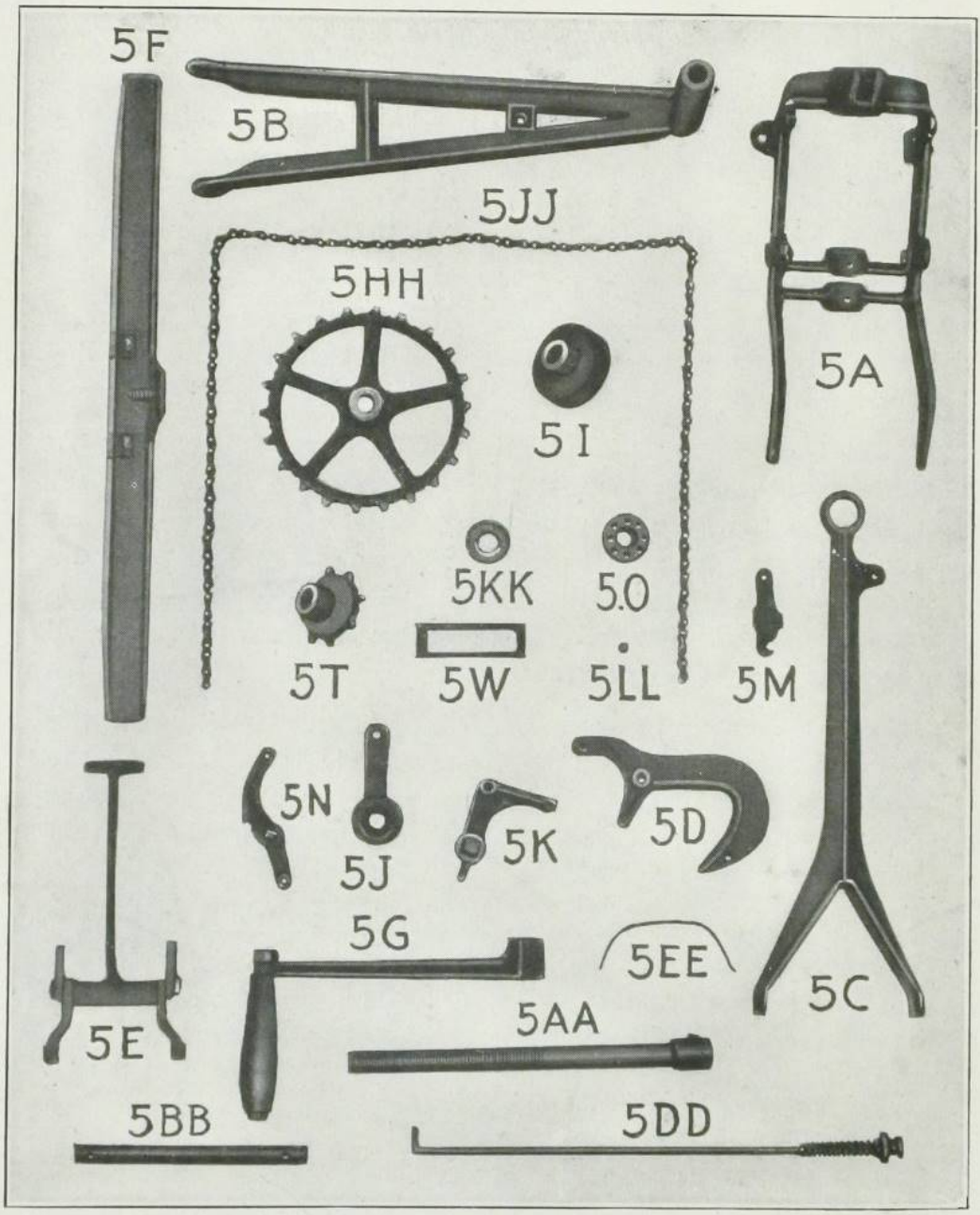
To reverse and return the drill spindle from the rail, simply press the thumb on lever "K" and turn the handles backward.

The feed is adjusted by nut "X" (in top of Fig. 15). To increase feed, screw nut "X" down, and to decrease feed, screw it up, which may be done while in operation, it not being necessary to stop the drill. The feed may also be decreased by pressing thumb on knob "Y" at the top of adjusting screw, and increased by pressing thumb against lever "K," while the drill is in operation.

After the hole has been drilled, or at any time during the operation, the hooks can be thrown up (Fig. 13), when the machine can be instantly removed, with no chance for hooks to catch under ball of rail or anything interfere with getting it away from the track instantly.

The hooks are arranged so that holes will be about center of web. Should engineer in charge desire to drill holes a certain distance from top of rail to center of hole, by being given distance and section of rail hooks it can be arranged accordingly.

Repair Parts for Moore Track Drill No. 5



Prices on opposite page.

Price List Moore Track Drill No. 5

June 18, 1907

5A	Base with center bearing and bolts	$2 50
5B	Upright	1 75
5C	Back brace	1 00
5D	Rail Hook	1 25
5E	Rail hook lever and links, R. and L.	1 25
5F	Foot plate	75
5G	Crank with wood handle and bolt	50
5I	Feed nut	1 80
5J	Idler arm with wheel and bolt	50
5K	Bell crank with feed roll and bolt	1 25
5M	Feed jaw or grip	75
5N	Grip lever and feed jaw	50
5O	Ball bearing adjusting nut	1 00
5T	Drive sleeve with key and sprocket	1 80
5W	Link for feed jaw	25
5AA	Spindle with set screw	1 25
5BB	Crank shaft	60
5DD	Feed rod with thumb nut, feed adjusting nut and springs	75
5EE	Feed jaw spring	15
5HH	Drive sprocket, 21 to 24 teeth	1 50
4JJ	Sprocket chain	85
5KK	Ball race thrust bearing	75
5LL	5-16 steel ball (11 per set)	30

The Smith Curve Lining Gauge

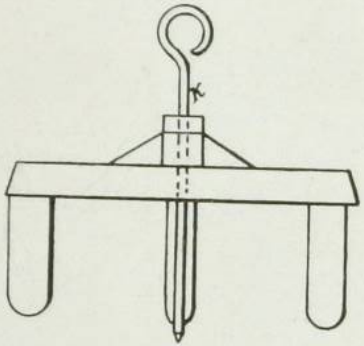


Fig. 1

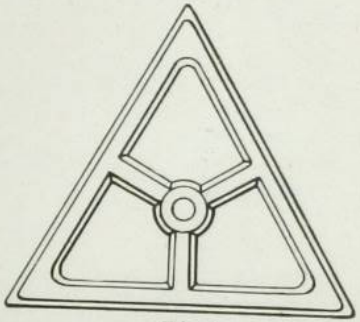


Fig 2

Fig. 3

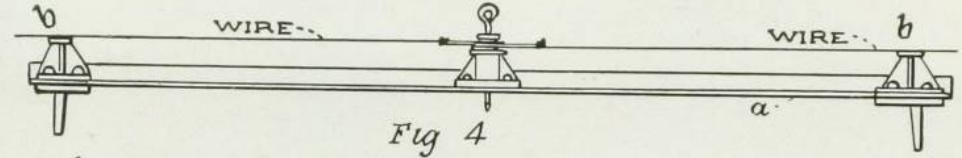


Fig 4

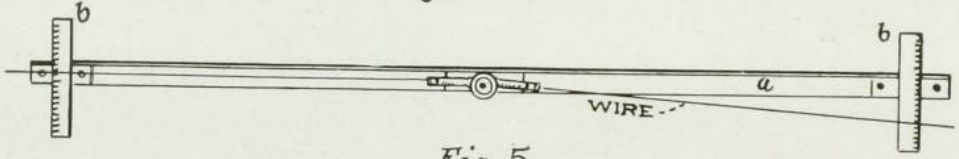


Fig. 5

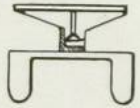


Fig. 6

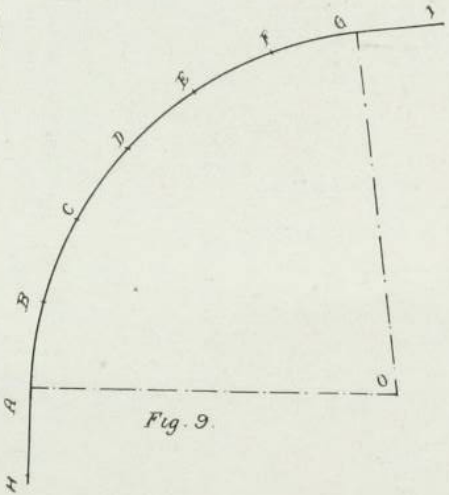
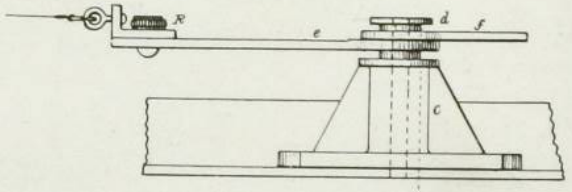


Fig. 9

Fig 7



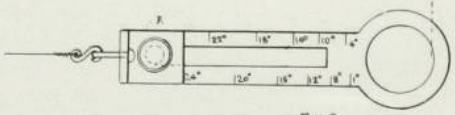


Fig 8

The Smith Curve Lining Gauge

Code Word—"SMITHAGE"

There is nothing more difficult for the track foreman to do than to line his curves properly. No matter how well he understands his work, he fails when he comes to adjust his curves, unless the engineer gives him center stakes every time the curve goes out of line.

The Smith Curve Lining Gauge, a description of which follows, will do away with all of these difficulties forever.

There need be no more guesswork, as the intelligent application of this tool will give points for the alinement of curves with the same precision as will the engineer with his transit, and the foreman and road master can then do this work any time they see fit.

Fig. 4 shows an elevation and Fig. 5 a plan of the tool. It is all made of steel, strong and light, weighing about 7 pounds. The center casting (C) has a hole bored through its center (see Fig. 8) into which fits center pin (Fig. 3). The raised castings (b) on either end of gauge carry each a nickel-plated graduation plate shown in Fig. 7. There is a pair of gauge lugs shown in Figs. 4 and 6 bolted under the gauge bar (A) at either end. The center casting (c) has a collar (d) around which two brass end pieces (e and f) can freely rotate (see Fig. 8). The measuring wires which are used as chords, are attached to these by suitable swivel hooks. The No. 1 curve gauge is graduated for 25-foot chords, and has a capacity up to 24° curves. The free end of the wire terminates in a ring which fastens to an end pin (K) shown in Fig. 1. A graduation on the end piece in connection with a movable rider (R) shown in figure 8 makes it easily adjustable for any curve. For instance, if the curve under consideration is 12° the sliding rider (R) is moved until edge cuts graduation at 12°. End pins (K) which are just like center pin shown in Fig. 3, pass through hole in triangular chair when the gauge is in use (see Figs. 1 and 2). Reels are provided to wind up the wire chords, and the whole is securely placed in a well made wooden box, which may be locked, and which is convenient to carry along on hand or inspection car.

How to Check an Existing Curve

Three men are required when using the gauge—two end men and one center man. To undo the wires it is best for one end man to attach ring to end pin, and, walking toward center, unroll the wire until hook is reached, which is then attached to end piece; he then walks back to his end pin. This brings one end man 25 feet from gauge; the other end man will do the same with other chord, and gauge is now ready for action.

The Smith Curve Lining Gauge

[CONTINUED]

Center man lays gauge on top of inner rail of curve, places center pin in position and moves gauge so that center pin bears against gauge face of rail; the two end men draw their wires taut and hold their pins against gauge face of same rail. The center man will observe that the two wires move over the graduations without binding, yet close enough for accurate reading, and then swing gauge about center pin until one wire crosses graduation at zero. The other wire then indicates the degree of curve.

If there are four men present, the fourth man keeps a check by noting down the readings. A few readings will tell approximately the degree of curve For instance, if first reading is $3\frac{3}{4}^\circ$, second reading $4\frac{1}{4}^\circ$, third reading 4°, the curve may be assumed to be 4°. If the point of curve is not known, the men walk toward the beginning of curve, and when near the beginning, place gauge on rail as indicated above, and take readings. The point of curve (P C) is reached by center man when rear chord on tangent indicates zero, and first chord on curve indicates 2°, or just half of curve. This point should be carefully marked on the rail, also drive a stake in middle of track, or tack if it falls on a tie. Now go over the curve, beginning at point of curve with gauge on top of inner rail, and mark down all the readings, keeping rear line always at zero. Let curve (A G, Fig. 9) be the gauge line of inside rail, and (A) the (P C). Then rear man holds his pin at (H) or 25 feet back on tangent; center man swings gauge until (A H) crosses zero line, then forward chord indicates curve between (A and B) where it crosses graduation. Since (A B) is first chord of curve, the angle indicated is the tangential deflection. Hence, if this reading shows 2° it indicates a 4° curve.

The tally man marks down this reading and the center man adjusts the end piece for the 4° curve; forward man marks point (B) with chalk on the gauge face of rail Then all three advance, center man goes to (B), rear man to (A) and forward man toward (C); center man adjusts rear end piece for the 4° curve, rear man holds his pin against gauge face of rail at (A), center man holds center pin against rail at (B) and swings gauge so rear line crosses graduation at zero, then forward string shows curve between (B) and (C) when it crosses graduation. If it crosses at $4\frac{1}{4}$ it is a $4\frac{1}{4}^\circ$ curve between (B) and (C). The tally man marks this down under the 2° of the preceding reading, front man marks point (C), and then they advance to the next position—the rear man to (B), the center man to (C) and front man to (D), when the preceding operations are repeated until the end of curve is reached. If (G) is the point of tangent (P T) then when center

The Smith Curve Lining Gauge

[CONTINUED]

man is at (G) with the curve gauge, the rear man's wire crossing zero at the graduation, the front man's wire should cross at 2°, the last deflection being again just half of the curve, and the chord (G I) will be part of tangent. Suppose that the readings marked down are as follows:

2, 4¼, 4, 4½, 3½, 3¾, 2; adding these seven readings together makes 24. There are just six chords on the curve, so divide 24 by 6, give 4, which is the average degree of curvature.

This is the general method to be followed in checking up any curve.

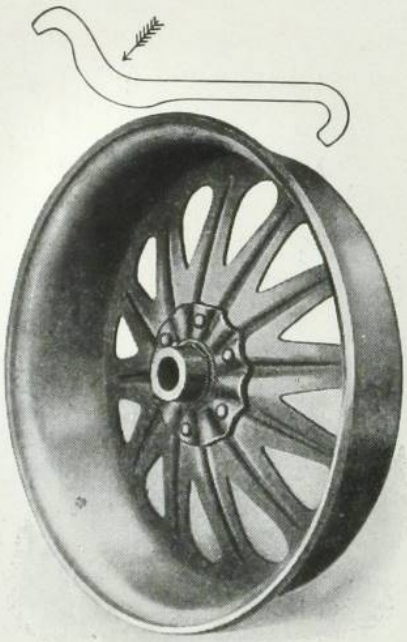
To Stake out the Curve

After the curve is checked up and (P C) fixed place guage between rails parallel therewith, so the center pin tallies with point (A) (see Fig. 9); assuming (A G) is center line of track; the point (H) is also to be fixed 25 feet back on tangent in the middle of track. The rear man holds the pin over point (H), center man holds center pin over point (A); he swings gauge until rear string crosses graduation at zero and lines forward chord until it crosses at 2°, the curve to be staked being a 4° curve. When forward string is in correct alinement, front man drives a stake at (B) and fixes point (B) by driving a tack in exact point, after the end piece has been adjusted for the 4° curve; then the three men walk ahead the length of the chord; the center man takes gauge to point (B), rear man goes to (A) and front man toward (C); center man adjusts rear end piece to the 4° curve, and rear man brings point of his pin over (A), center man makes center pin to tally with point (B), and swings gauge so rear string tallies with zero point, and he then lines in forward string until it crosses graduation at 4°; front man drives a stake at this point and fixes point (C) precisely by driving in a tack. Then the three men walk ahead again in the length of a chord, center man takes gauge to point (C), rear man goes to (B) and forward man to (D), where point (D) is fixed as above. In like manner all points are fixed on curve until (P C) at (G) is fixed, then the point (I) on tangent is fixed in the following manner: The three men walk ahead again, center man from (F) to (G), rear man from (E) to (F) and front man walks towards (I); rear man is lined to zero and forward man to 2° (half of curve being laid); then front man's point indicates point (I), and chord (G I) is first chord on tangent.

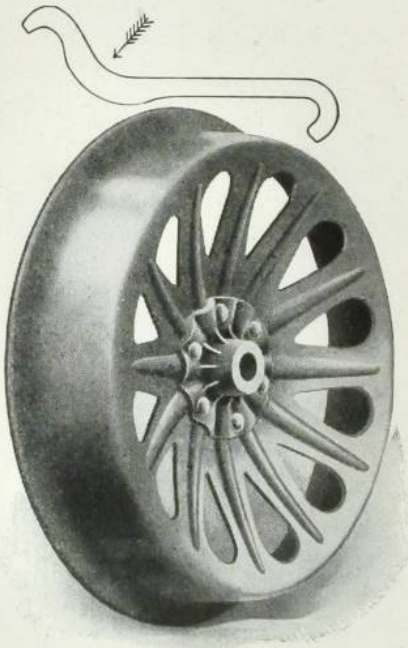
The above just gives a general outline how to use the tool. It may be used for many other purposes, and a book giving full instructions how to use it for various problems, is furnished free with every gauge.

The Kalamazoo Improved Pressed Steel Wheel

Is the Ideal Wheel for Hand and Push Cars



INSIDE VIEW



OUTSIDE VIEW

Made in three sizes—16-inch, 20-inch and 24-inch.
Our method of insulation has been approved by Hall, Taylor, General and other signal companies.

The Kalamazoo Improved Pressed Steel Hand Car Wheel

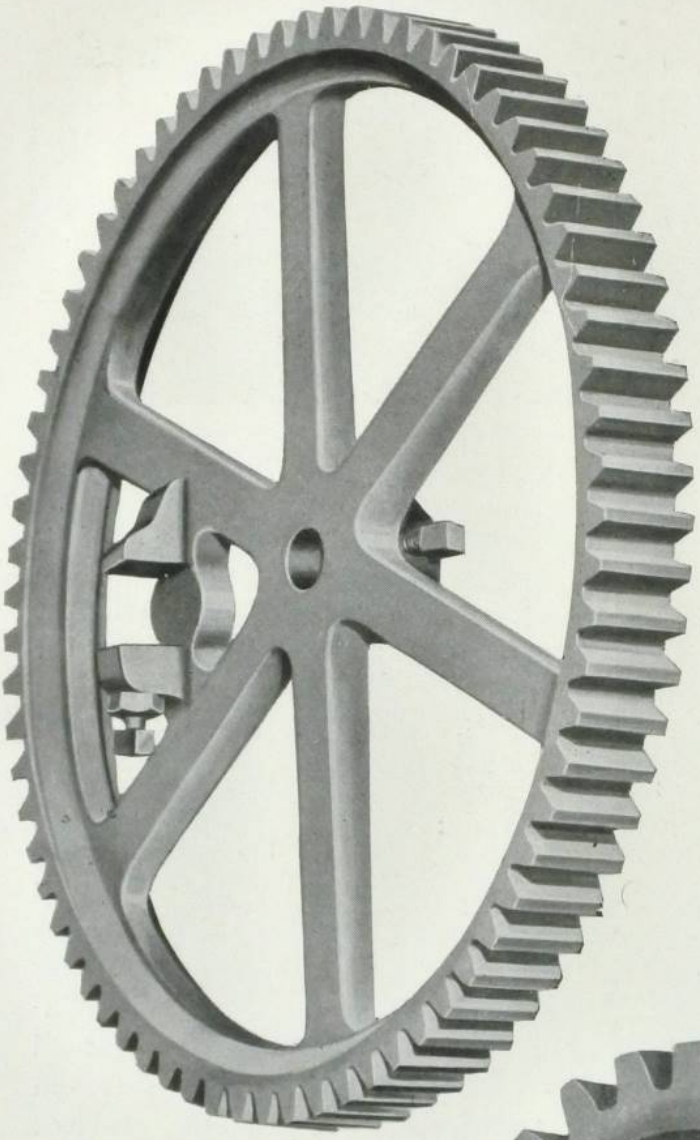
PATENTED

SECTIONAL VIEW

THE WHEEL is the most important feature in the construction of hand and push cars, because it receives more wear than any other part, and is, therefore, the greatest item in the maintenance of the car. To meet the demand for a wheel having greater wearing qualities, we have designed and placed on the market the Kalamazoo Improved Pressed Steel Wheel, which we claim and can prove is without any exception the best hand or push car wheel ever made.

The principal fault of all Pressed Steel Wheels, heretofore placed on the market is the tendency to quickly wear through in the throat of the flange, due to the thinness of the metal at this point, thus causing the flange to break off and putting the car out of service. By the use of special machinery constructed for this purpose, the metal in the Kalamazoo Wheel is rolled so as to increase it to about double the thickness in the throat of the flange, where the greatest wear comes. *See cut.*

The rolling process in finishing our wheels, not only increases the thickness of the metal in throat and flange, where most needed, but also increases the wearing qualities, as it is a well known fact that the rolling makes the metal more dense. For this reason we have no hesitancy in saying that our wheel will give from 50 to 100% greater service than any wheel of similar weight or design on the market. Our special hydraulic machinery used for pressing the hubs in place and riveting them enables us to absolutely guarantee that the hubs of the Kalamazoo Improved Pressed Steel Wheels, will not work loose under the ordinary heavy loads.

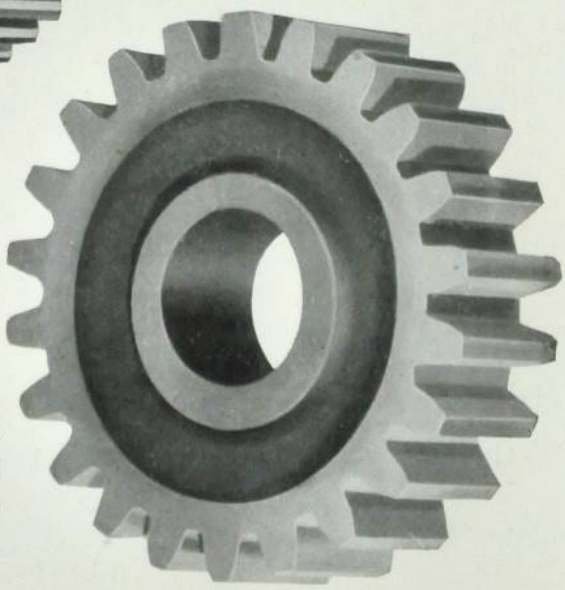


Kalamazoo Standard Hand Cars

Are equipped with

"Cut Gears

Machine Cut Gears and Pinions for Hand Cars



We can furnish car equipped with cast gears at reduced price, but we recommend the cut gears at all times.

Cut Gears Used on all Kalamazoo Standard Hand Cars

ALL of our Standard Hand Cars are equipped with machine cut driving gear and pinion, which are cut on the latest improved automatic gear cutting machines, insuring accuracy.

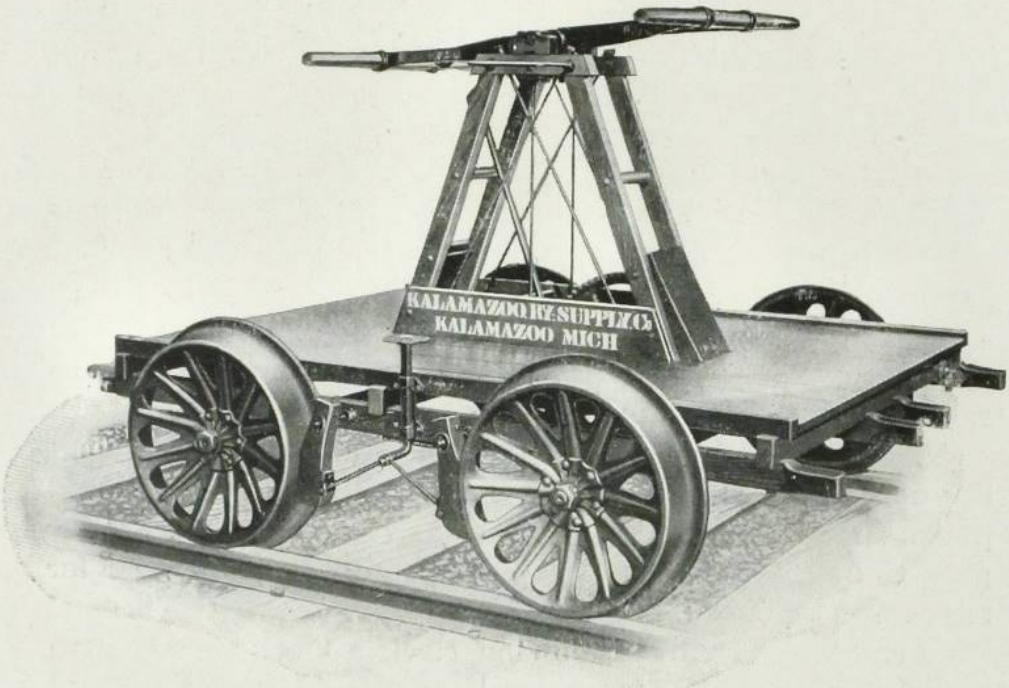
The teeth of the machine cut gears being uniform in size and shape, there is less friction in operation, hence the car runs easier and the life of the gears is lengthened.

The axles on our cars are made of steel and of sufficient size according to the work required of them. The wheels and pinion are made with taper fit, which we find is the better plan, as by this method the wheels can be easily removed for any reason whatever.

Insulation, Railroads having electric block signals with track circuit. We are prepared to furnish our Improved Pressed Steel wheel, shown on page 42, perfectly insulated. Our method of insulation has been approved by the Hall-Taylor and other Signal Companies.

We can furnish cars with cast gears at a reduced price but we recommend the cut gears at all times.

No. 1 Standard Section Hand Car



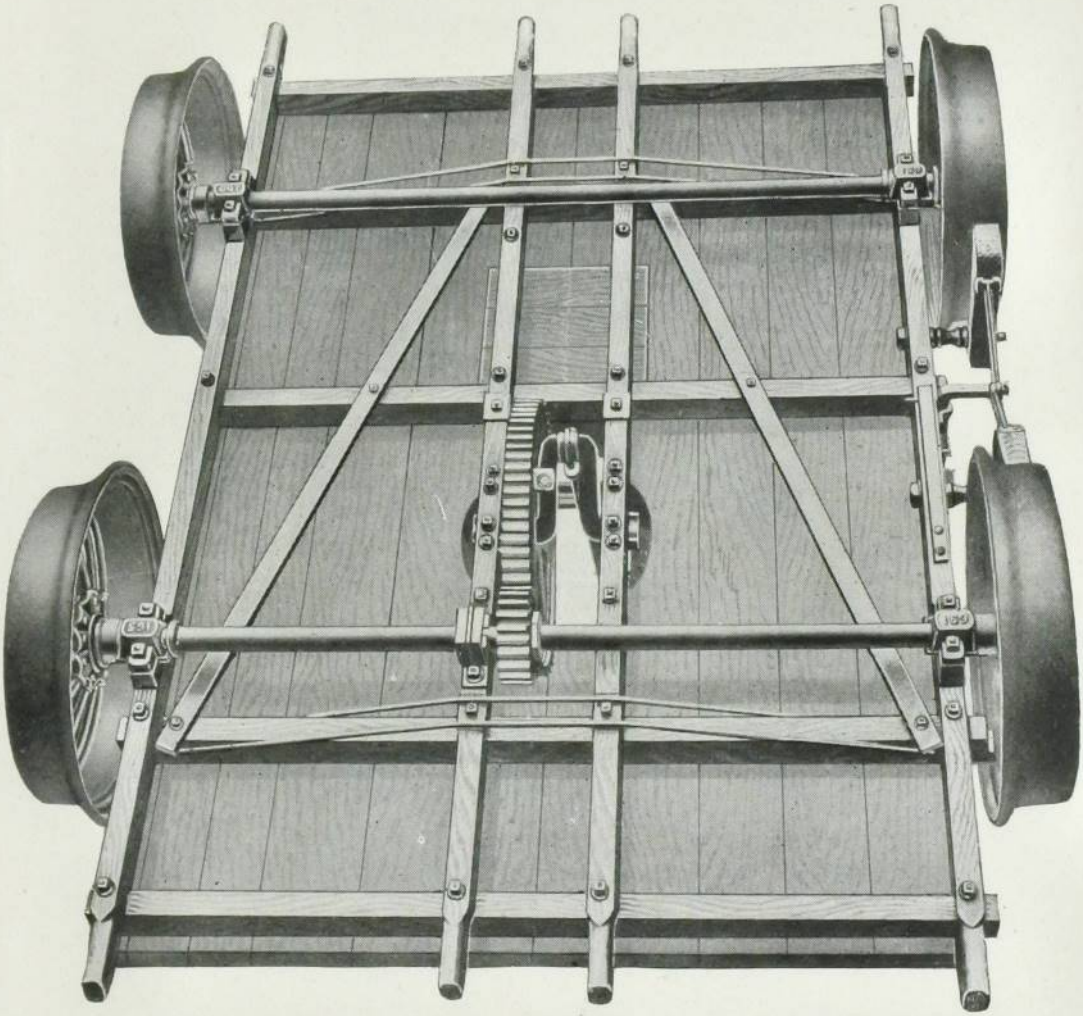
Code Word—"HANDCAR"

Platform 6 ft. long, 4 ft. 4 in. wide; axles 1½ in.; bearings 3 in.; 20 in. diameter Kalamazoo Improved Pressed Steel Wheels furnished unless otherwise specified; weight, 510 lbs.; packed for export, 750 lbs.; 35 cu. ft.

This cut shows car built for standard 4 ft. 8½-in. gauge. When built to narrower gauge it takes the form of No. 6 Narrow Gauge Hand Car.

We make 16 different styles of Hand Cars, standard and special, and can make them any gauge desired.

No. 1 Standard Section Hand Car

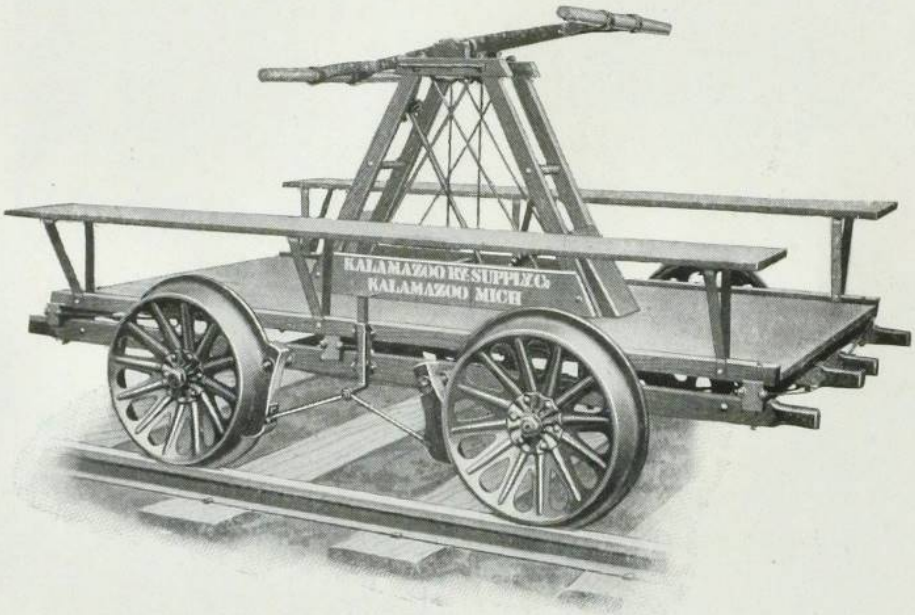


BOTTOM VIEW OF HAND CAR—Showing the truss rods and braces.

The Kalamazoo Hand Car is high grade throughout, and embodies all the desirable features, such as: taper wheel and pinion-fit axles; machine cut gears; 20-inch diameter pressed steel wheels; flexible steady-box; double acting brake; specially stout gallows-frame, thoroughly trussed.

We make 16 different styles of Hand Cars, standard and special, and can make them any gauge desired.

No. 2 Extra Gang Hand Car

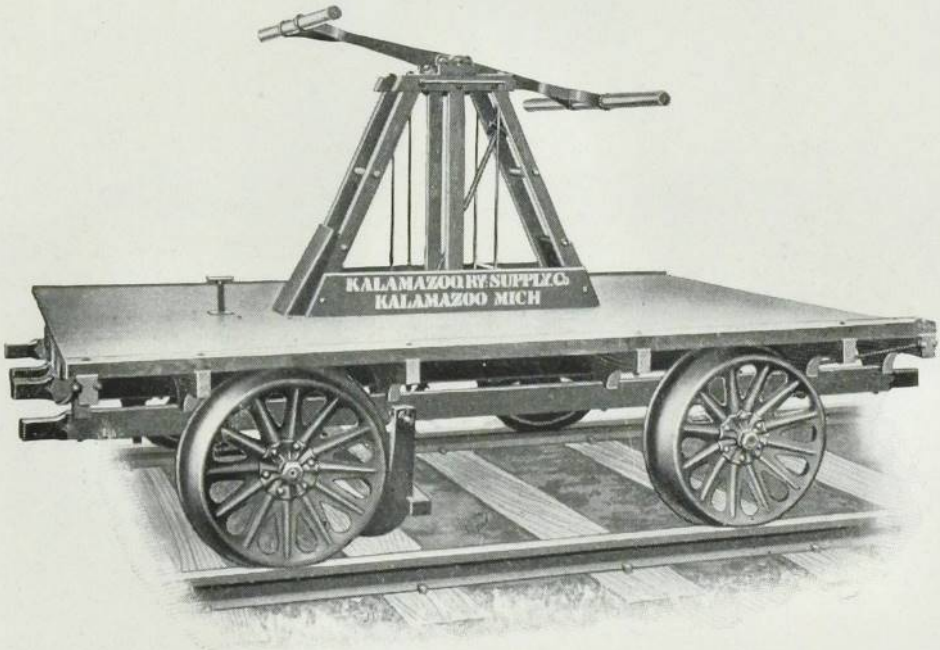


Code Word—"SIDESEATS"

Platform 7 ft. 6 in. long, 4 ft. 4 in. wide; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels furnished unless otherwise specified; walking beam 4 in. longer than used on No. 1 Hand Car, giving greater leverage; carries 12 to 14 men; weight, 625 lbs.; packed for export, 925 lbs., 43 cu. ft.

We make 16 different styles of Hand Cars, standard and special, and can make them any gauge desired.

No. 3 Standard Bridge Gang Hand Car

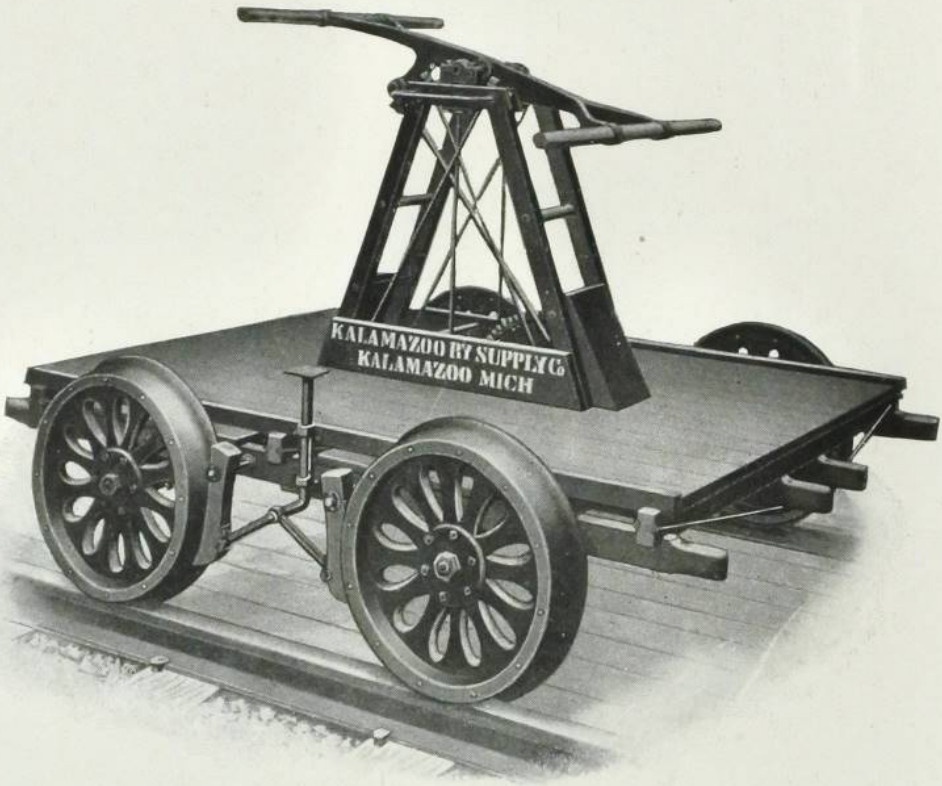


Code Word—"BRIDGE"

Platform 8 ft. long, 5 ft. 8 in. wide; capacity, 12 to 15 men and tools; axles 1¾ in. in diameter; standard with inside bearings; intermediate gears used to gear to driving axle; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels; weight, 735 lbs.; packed for export, 1085 lbs., 65 cu. ft.

We make 16 different styles of Hand Cars, standard and special, and can make any gauge desired.

No. 4 Light Weight Section Hand Car

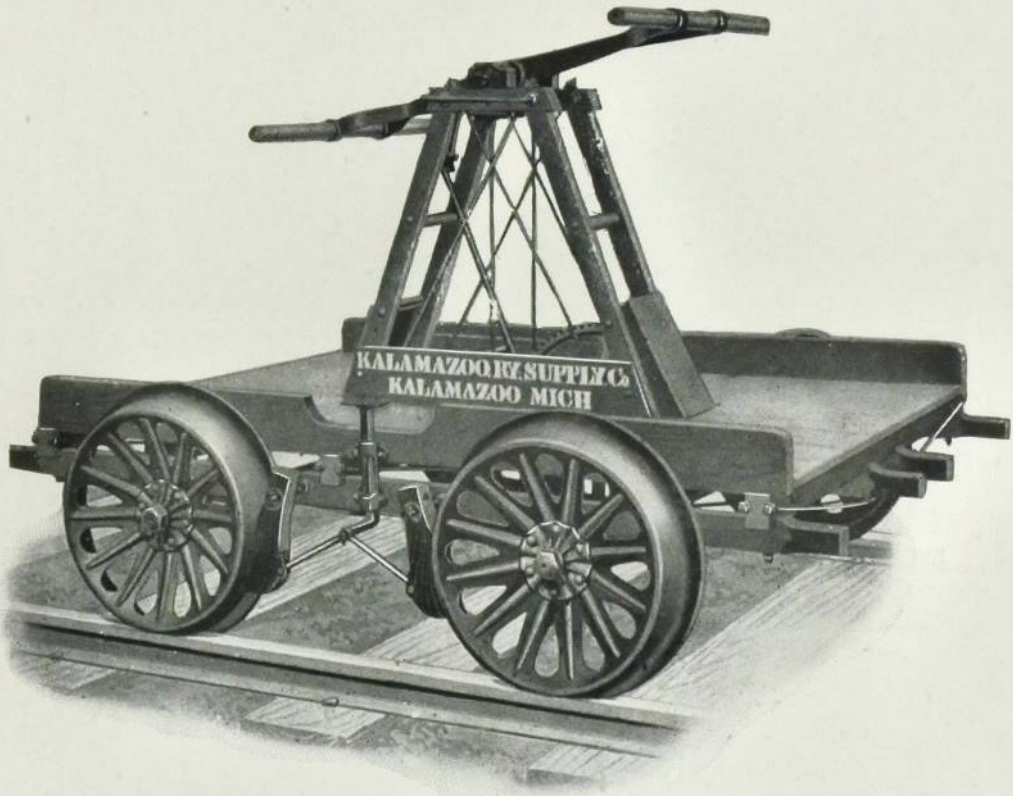


Code Word—"LITWEIT"

Platform 6 ft. long, 4 ft. 4 in. wide; axles 1½ in.; taper wheel and pinion fit; cut gears; bearings 3 in.; wheels 20 in. diameter, wood center with steel tires; weight, 490 lbs.; packed for export, 725 lbs., 35 cu. ft. Can be equipped with wood center or our Improved Reinforced Steel Wheels.

We make 12 different styles of Hand Cars, regular and special, and can make any gauge desired.

No. 5 Special Hand Car



Code Word—"SIDERAIL"

Platform 6 ft. long, 4 ft. 4 in. wide ; high side rails to retain tools ; axles 1½ in.; bearings 3 in.; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels furnished unless otherwise specified ; weight, 520 lbs.; packed for export, 775 lbs., 35 cu. ft.

We make 12 different styles of Hand Cars, regular and special, and can make any gauge desired.

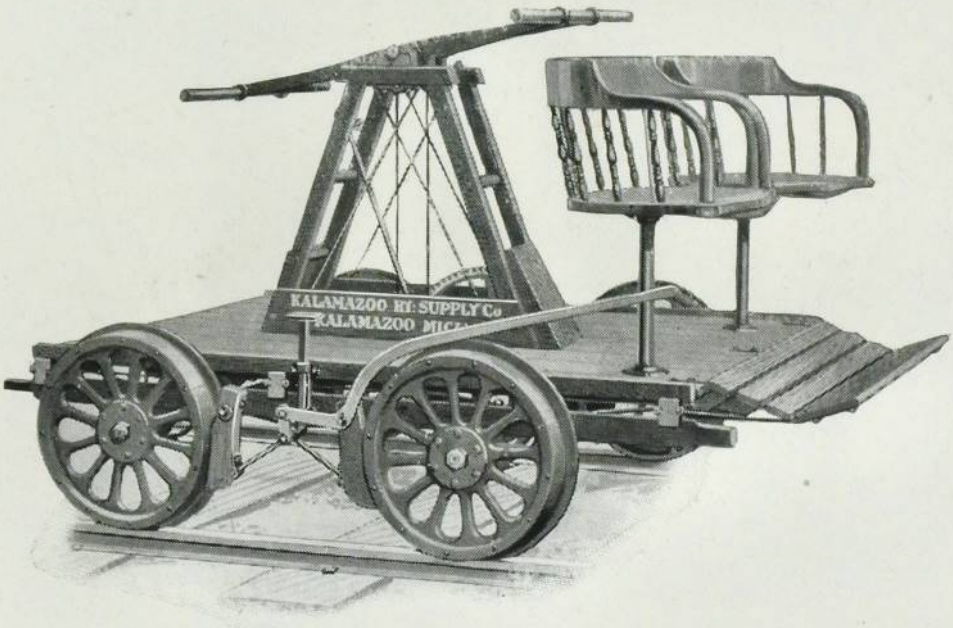
No. 6 Narrow Gauge Section Hand Car

Code Word—"SIXROW"

Platform 6 ft. 4 in long, 4 ft. 1 in. wide; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels furnished unless otherwise specified; bearings 3 in.; axles 1½ in.; weight in 3-ft. gauge, 570 lbs; packed for export, 830 lbs., 38 cu. ft.

We make 12 different styles of Hand Cars, regular and special, and can make any gauge desired.

No. 9 Light Inspection Car

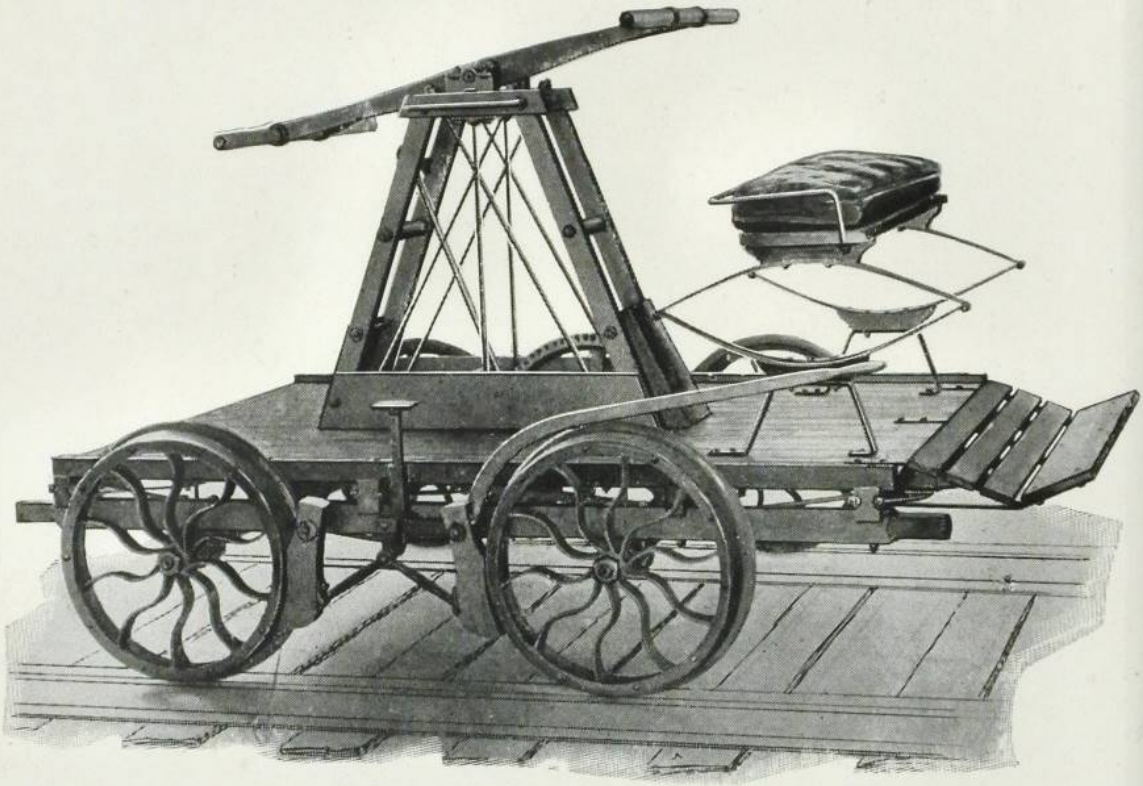


Cipher—"LIGHTIN"

Platform 6 ft. long, 4 ft. 4 in. wide; axles 1¼ in.; wheels 20 in. diameter, wood center with steel tires; lightest car built; weight, 430 lbs. Can be equipped with wood center or our Improved Reinforced Pressed Steel Wheel.

We make six different styles of Inspection Cars—can make any gauge desired.

No. 10 Inspection Hand Car

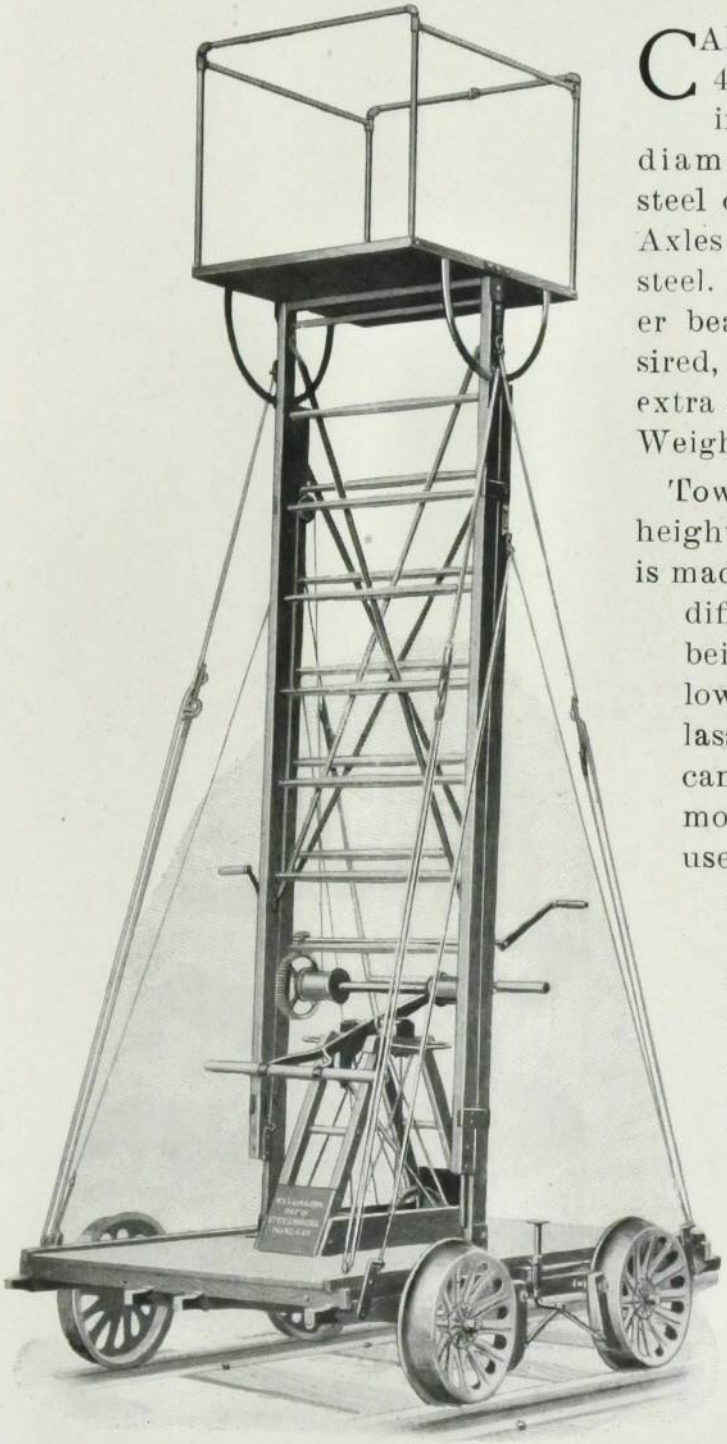


Cipher—"FOREHAND"

Capacity, three inspectors and four drivers; double brake can be applied by inspector or operator; wheels all metal or wood center, 20 in. diameter; weights, gross 850 lbs., net 580 lbs.; packs 47 cu. ft; built any gauge. Can be equipped with our wood center or our Improved Reinforced Steel Wheel.

We make six different styles of Inspection Cars—can make any gauge desired.

Kalamazoo Tower Hand Car



Cole Word—"TOWER"

CAR platform 4 ft. 4 in. x 7 ft. 6 in. Wheels 20 in. diameter, pressed steel or wood center. Axles 1½ in. diameter, steel. Fitted with roller bearings when desired, for which an extra charge is made. Weight, about 800 lbs.

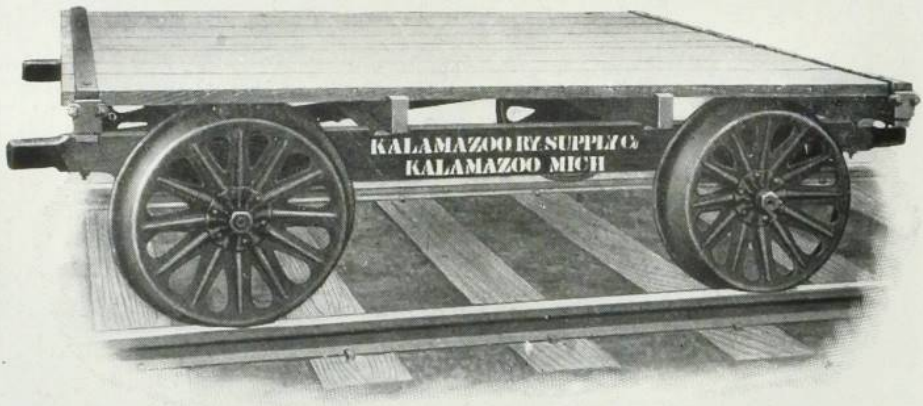
Tower is built to any height specified, and is made adjustable to different heights, being raised and lowered with windlass and cable. It can be easily removed and car then used as an ordinary section car.

This car is *always ready* to be run over the rails directly to breaks, which are often inaccessible to horses and wagons.

Easy running; Substantial; Insulated; Cheaper than a wagon; no horses to maintain.

A TIME AND MONEY SAVER

No. 16 Standard Section Push Car

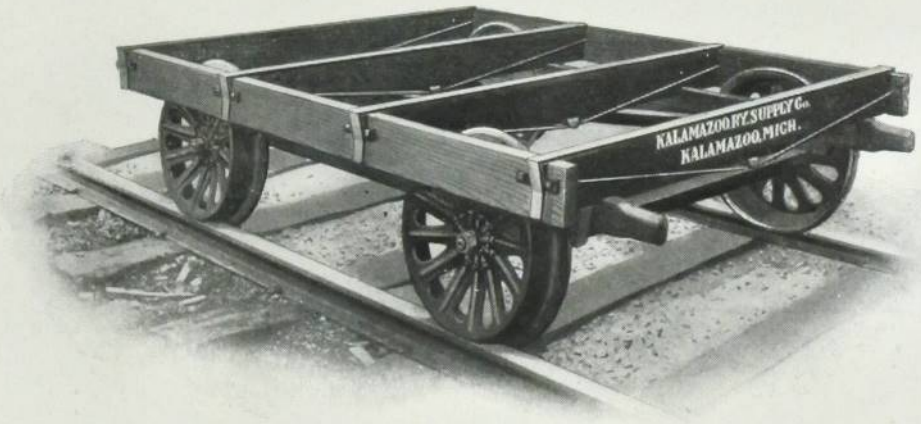


Code Word—"STANDSTEEL"

Platform 7 ft. long, 5 ft. 8 in. wide; frame and deck of seasoned hardwood; axles 1½ in. diameter, taper wheel fit; bearings brass; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels; ends strapped with 2 x ½ in. iron; weight, 475 lbs.; packed for export, 730 lbs., 67 cu. ft. No. 16½ is our extra heavy Push Car.

We make 10 different styles of Push Cars, standard and special, and can make any gauge desired.

No. 17 Push Car

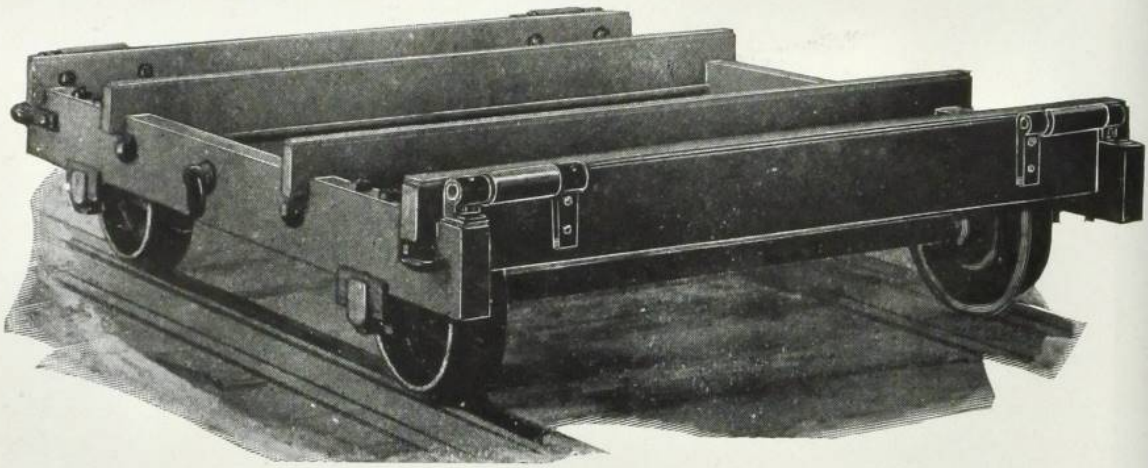


Code Word—"DECKLESS"

Frame 7 ft. long, 5 ft. 8 in. wide; of seasoned hardwood; without deck, sills being covered with heavy bands of steel; axles 1½ in. diameter, taper wheel fit; bearings, brass; 20-in. diameter Kalamazoo Improved Pressed Steel Wheels; weight, 475 lbs.; packed for export, 730 lbs., 67 cu. ft.

We make 10 different styles of Push Cars, standard and special, and can make any gauge desired.

No. 8 Rail Car

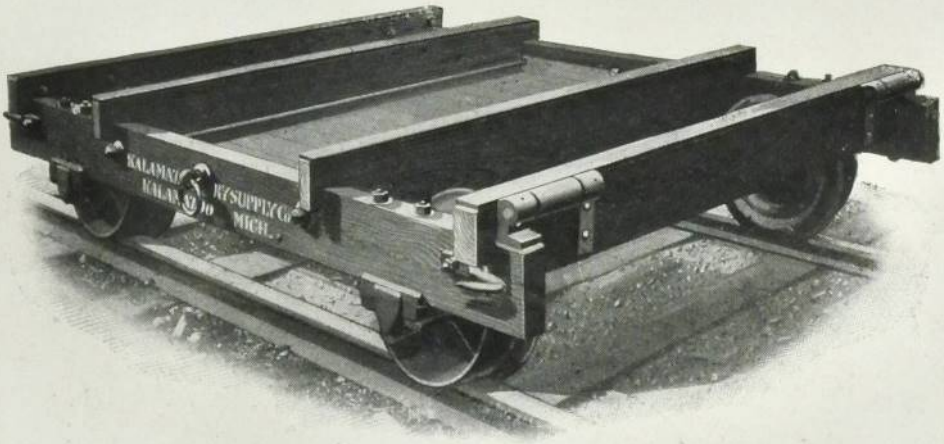


Cipher—"RAILCAR"

For use of track layers. Wheels 16 in. diameter, weighing 104 lbs. each; side and cross sills covered with 3 x ¼ in. iron; two rollers at each end; axles 2½ in. diameter with outside bearings babbit metal; capacity, 10 to 12 tons; 8 ft. long and 6 ft. 1 in. wide over all; weights, gross 1650 lbs., net 1450 lbs.; packs 94 cu. ft.

This car can be made any gauge desired.

No. 8½ Extra Heavy Track Laying or Rail Car



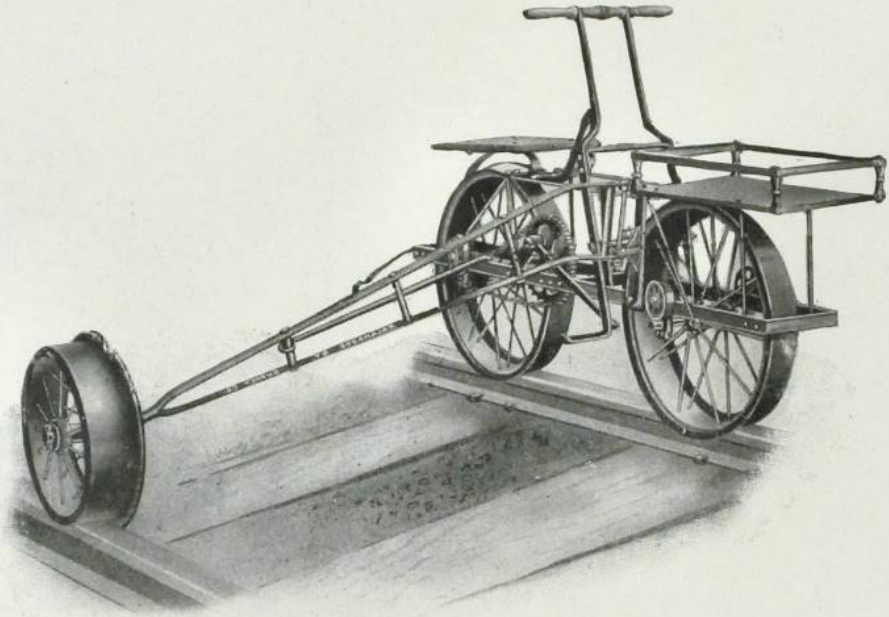
Code Word—"IRONCAR"

Frame 8 ft. long, 6 ft. 7½ in. wide, of thoroughly seasoned oak, gained and reinforced by tie-rods; cross beams faced with flat steel bars; axles 2¾ in. diameter; wheels 16 in. diameter, 6 in. tread; capacity, 10 to 12 tons. Stout hooks for pulling car are provided, one at each corner, and heavy rings on each side for lifting with derrick; two rollers at each end to facilitate handling iron; weight, 1620 lbs.; packed for export, 1850 lbs., 112 cu. ft.

This car can be made any gauge desired.

No. 00 Steel Velocipede Car

Code Word—"SPEEDONE"



This cut shows Car seated for one person.

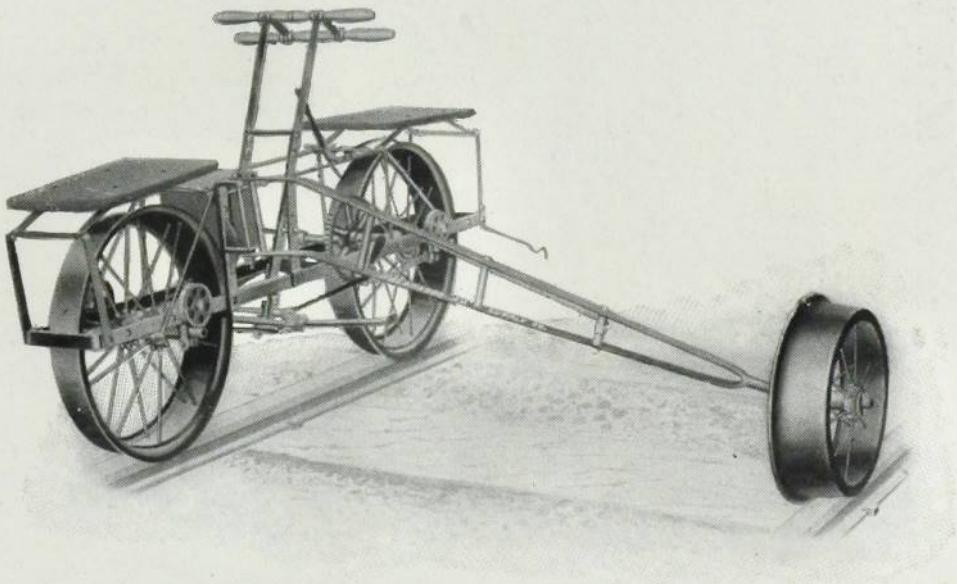
Constructed from steel and malleable iron ; frame trussed to give maximum strength and minimum weight ; axles revolve under anti-friction rollers ; geared $3\frac{1}{3}$ to 1. Wheels 20 and 14 in. diameter.

Outer third wheel arm can be swung into position parallel with drive wheels so as to occupy small space in shipping. Weight, 135 lbs.; packed for export, 270 lbs , 16 cu. ft.

We make 20 different styles of Velocipedes, steel and wood frames, and can make any guage desired.

No. 0 All Steel Velocipede Car

Code Word—"SPEEDER"



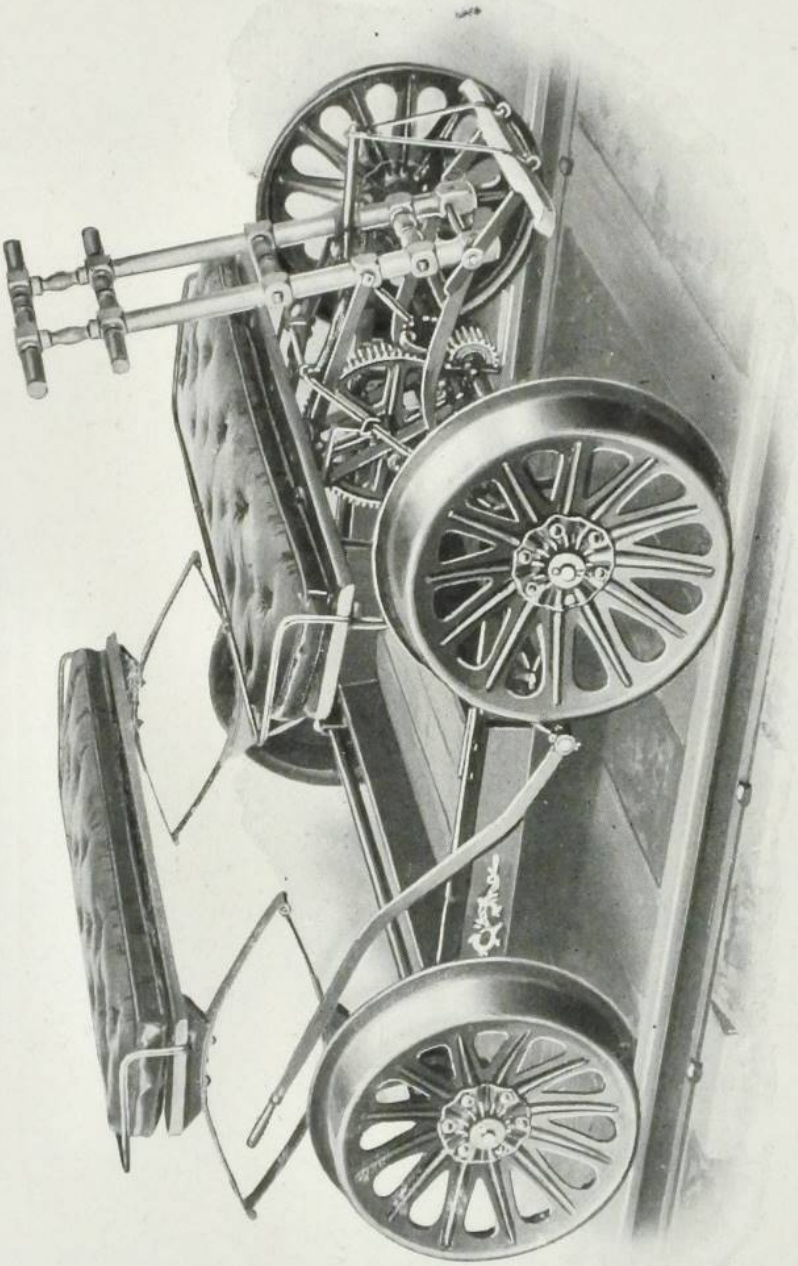
This cut shows Car seated for two persons

Constructed from steel and malleable iron; frame trussed to give maximum strength and minimum weight; axles revolve under anti-friction rollers; geared 3⅛ to 1. Wheels 20 and 14 in. diameter.

Outer third wheel arm can be swung into position parallel with drive wheels so as to occupy small space in shipping. Weight, 170 lbs.; packed for export, 325 lbs., 17 cu. ft.

We make 20 different styles of Velocipedes, steel and wood frames, and can make them any gauge desired.

No 4 Pleasure and Mail Velocipede

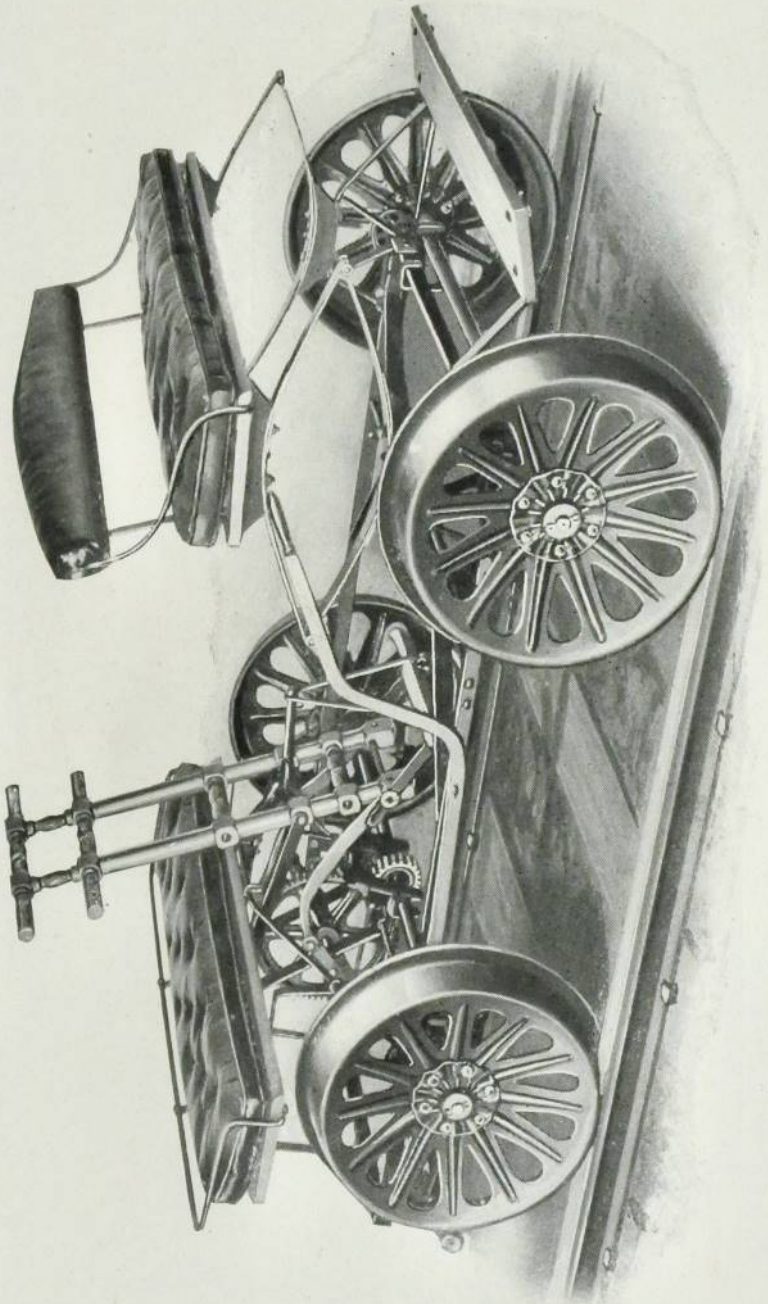


Code Word—"COMBIN"

The above illustration shows a very convenient railway vehicle that can be used either for pleasure or business by one to four persons. By removing rear seat it can be used for carrying mail sacks, packages, or light baggage, as the car is provided with a commodious tray. Built any gauge. Steel axles $1\frac{1}{8}$ in. diameter; pressed steel wheels 20 in. diameter; weight, 375 lbs.; packed for export, 525 lbs., 33 cu. ft.

We make six different styles of Inspection Cars, standard and special.

No. 6 Inspection Velocipede

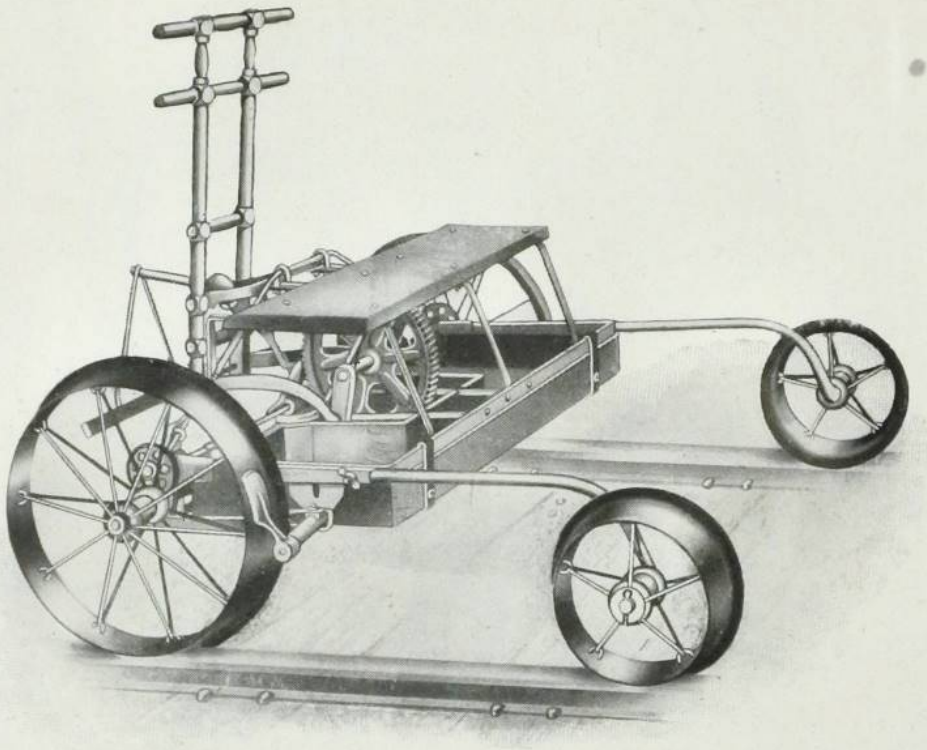


Code Word—"INSPEC"

While the car shown by this illustration is designed more particularly for track inspection, it will be found very convenient for many other purposes. Carries four people. Built any gauge. Steel axles 1⅛ in. diameter; pressed steel wheels 20 in. diameter; weight, 430 lbs.; packed for export, 650 lbs , 44 cu. ft.

We make six different styles of Inspection cars, standard and special.

No. 7 All Steel Velocipede Car



Code Word—"ATTACHMENT"

Frame made of steel and malleable iron ; wheels, suspension tension spoke pattern, 20 and 14 in. diameter ; axles revolve under anti-friction rollers ; geared 3½ to 1. The best and lightest velocipede on sharp curves and steep grades. Extensively used by switch lamp tenders. Special tray for carrying lamps furnished when ordered. Built any gauge. Weight, 195 lbs.; packed for export, 340 lbs., 19 cu. ft.

We make 20 different styles of Velocipedes, steel and wooden frames.

No 9 Officials' Velocipede

Cipher—"OFFICIALS"

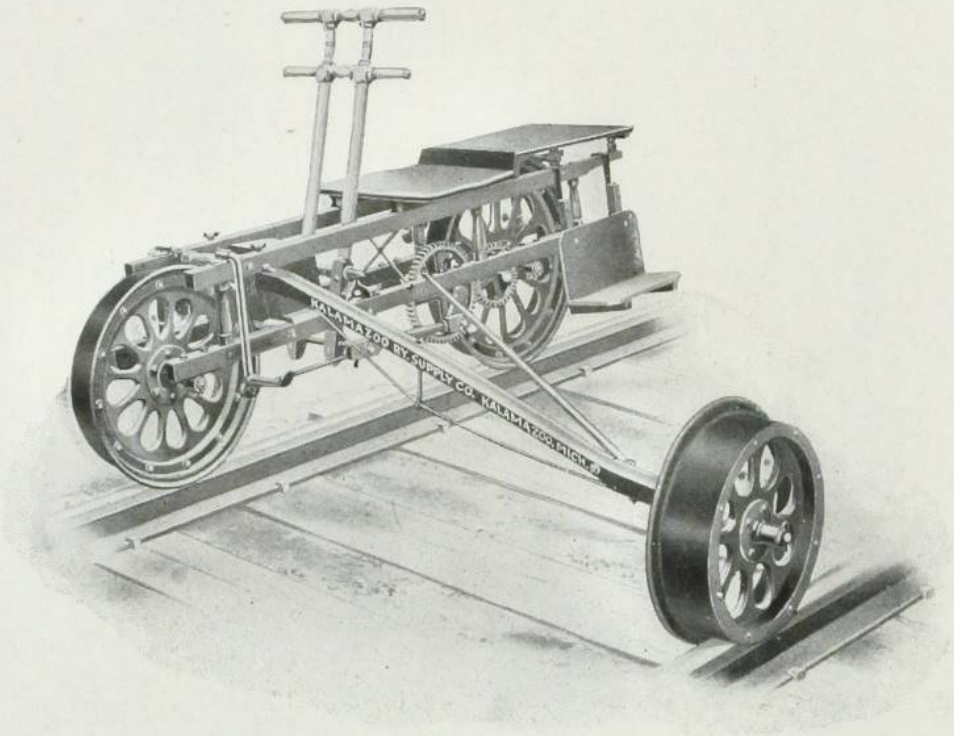
Axles 1⅛ in. diameter; wheels 20 in. diameter; weight, gross, 625 lbs., net 475 lbs.; packs 30 cu. ft.; built any guage.

Same velocipede supplied with buggy top style of canopy over front seat only, if so desired, and spring seat front and driving levers in rear. This modification is known as No. 8. Cipher—"BUGGY TOP."

We make six different styles of Inspection Cars, standard and special.

No. 12 Wood Frame Velocipede Car

Ball Bearings



Code Word—"WOODEN"

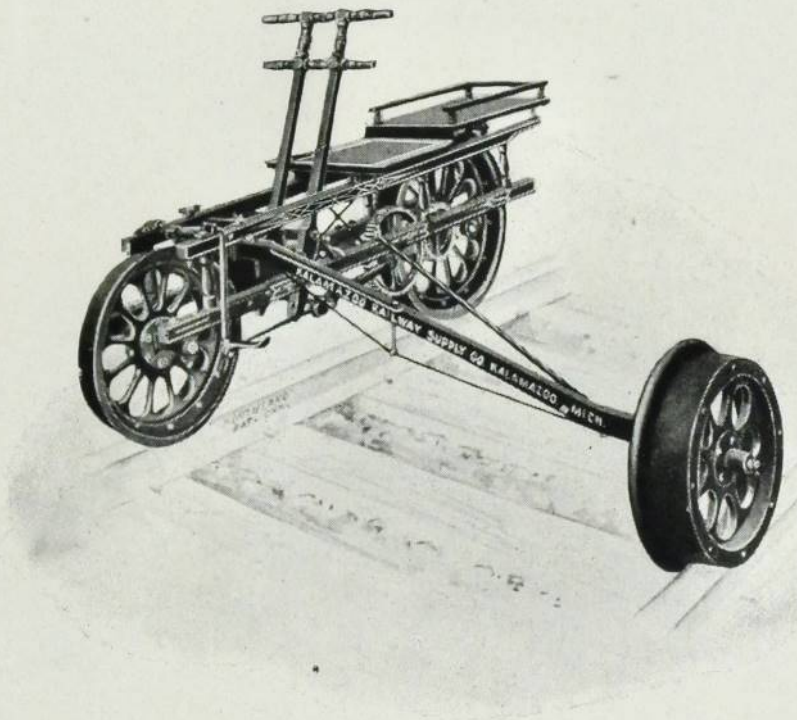
Wood frame; wood filled wheels, 20, 17 and 14 in. diameter; cut gears; highest grade ball bearings and tool steel axles; built any gauge; weight, 150 lbs.; packed for export, 300 lbs., 19 cu. ft.

Arm adjustable to different gauges supplied without extra cost, if so ordered initially.

We make 20 different styles of Velocipede Cars, steel and wooden frames.

No. 13 Velocipede Car

Ball Bearings



Code Word—"WOODBINE"

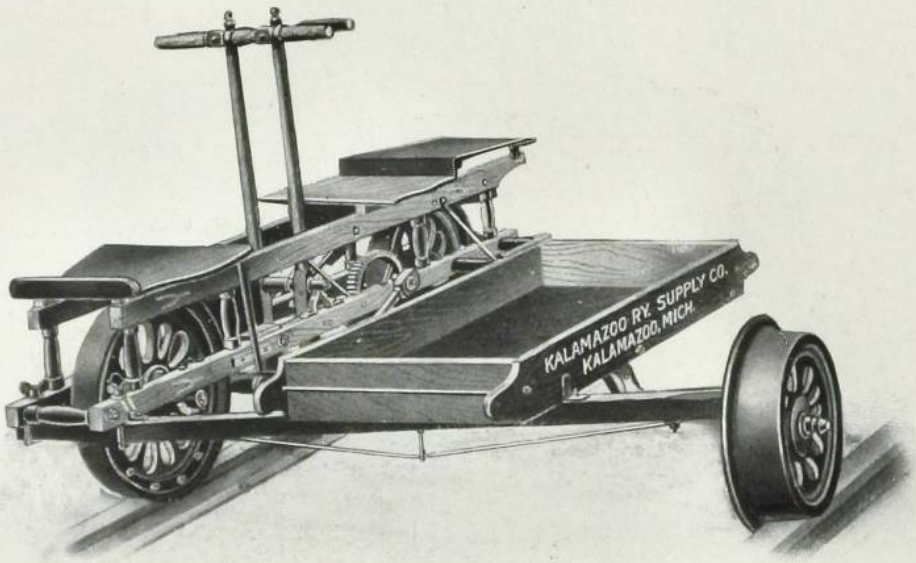
Wood frame; wood filled wheels, 20, 17 and 14 in. diam eter; cut gears; highest grade ball bearings and tool steel axles; seat and foot-rest behind operator for second person; built any gauge; weight, 150 lbs.; packed for export, 300 lbs., 19 cu. ft.

Arm adjustable to different gauges supplied without extra cost, if ordered initially.

We make 20 different styles of Velocipede Cars, steel and wooden frames.

No. 14 Wood Frame Velocipede Car

Ball Bearings



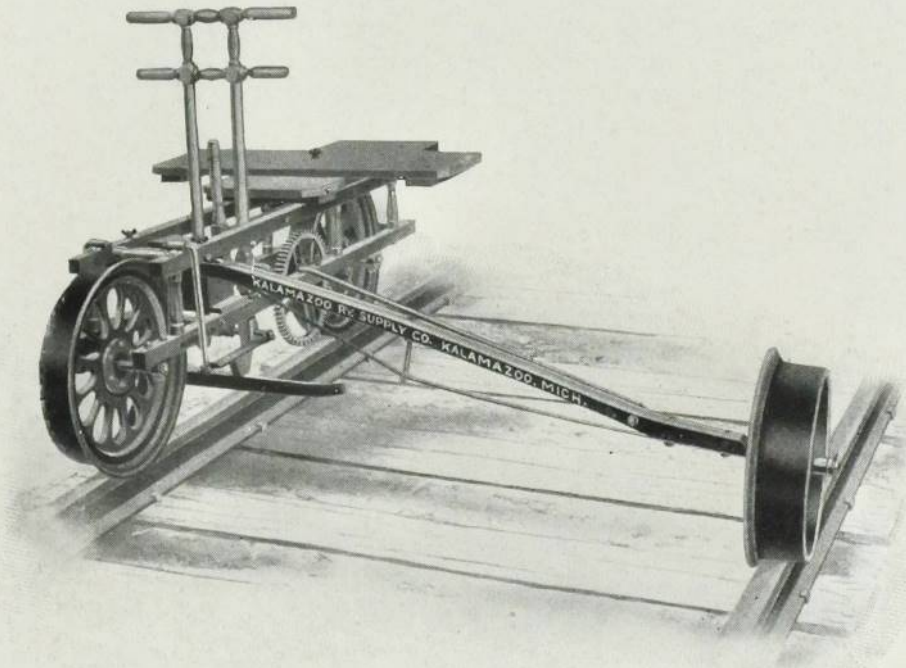
Code Word—"WOODBRIDGE"

Wood frame; wood filled wheels, 20, 17 and 14 in. diameter; cut gears: highest grade ball bearings and tool steel axles; tray for wire and tools; seated for three people; built any gauge; weight, 185 lbs.; packed for export, 400 lbs, 21 cu. ft.

We make 20 different styles of Velocipede Cars, steel and wooden frames.

No. 15 Velocipede Car

Ball Bearings



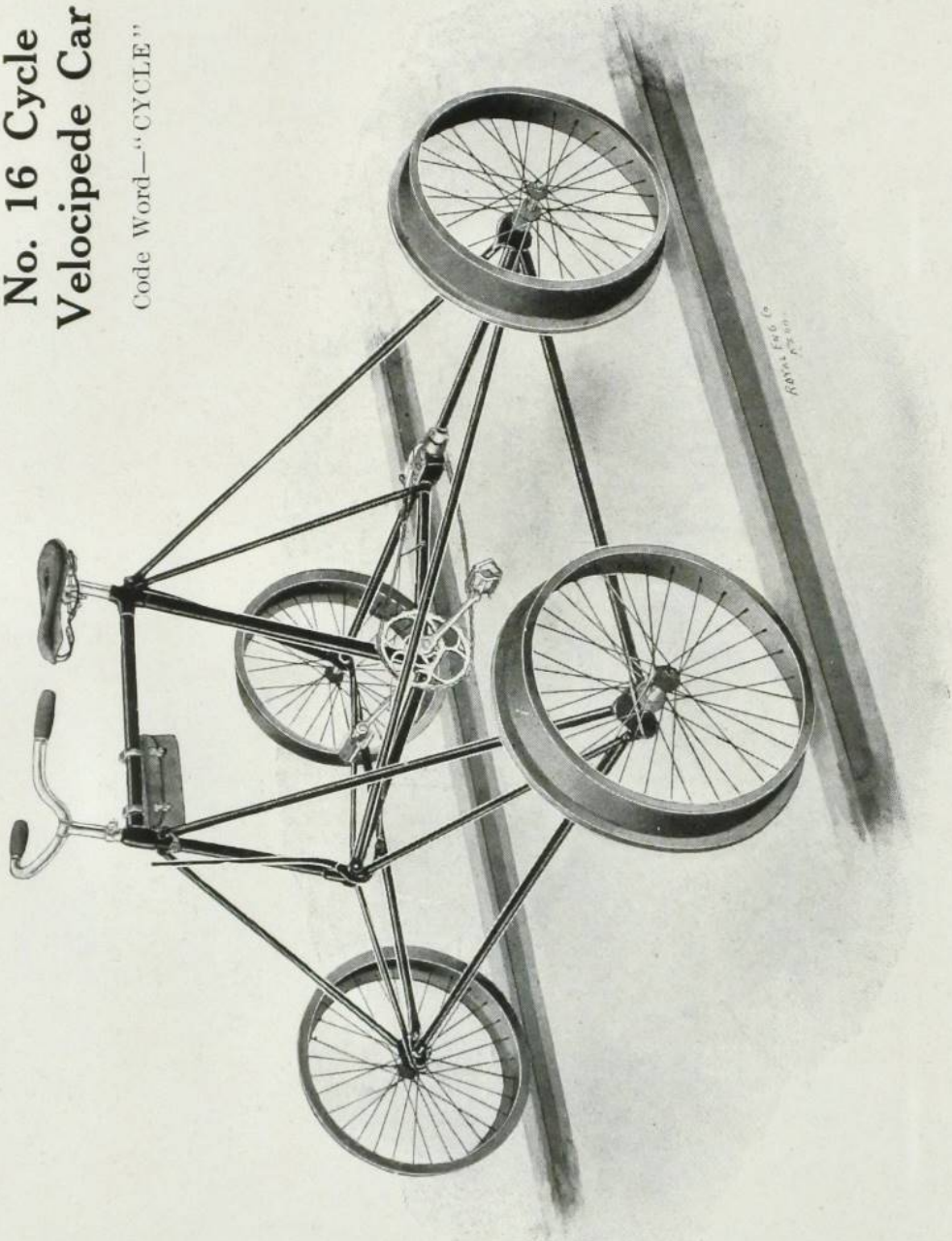
Code Word—"WOODRUFF"
Showing Car arranged for two riders.

Wood frame; wood filled wheels, 20, 17 and 14 in. diameter; cut gears; highest grade ball bearings and tool steel axles; has folding seat to accommodate one rider or two, either or both propelling; built any gauge; weight, 165 lbs; packed for export, 345 lbs., 19 cu ft.

We make 20 different styles of Velocipede Cars, steel and wooden frames.

No. 16 Cycle Velocipede Car

Code Word—"CYCLE"

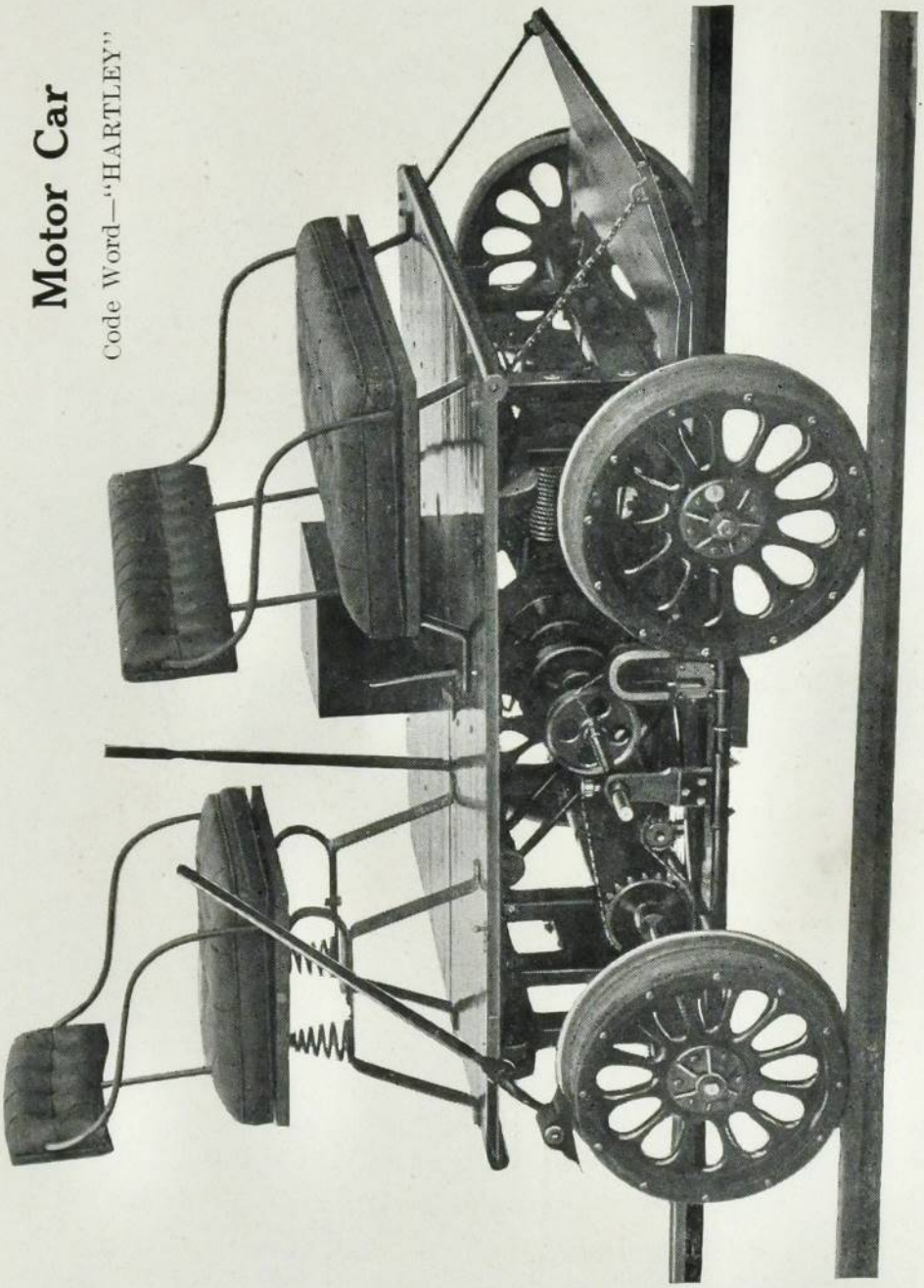


Frame seamless drawn tubing; wheels, 17 in. diameter, wire tangent spokes, weldless steel tires, rubber banded; ball bearing throughout; band brake; built any gauge; weight, 65 lbs.; packed for export, 230 lbs., 49 cu. ft.

We also build similar car for two riders. On the two-man Velocipede Car we have a neatly arranged seat for third person, and is used on inspection.

Motor Car

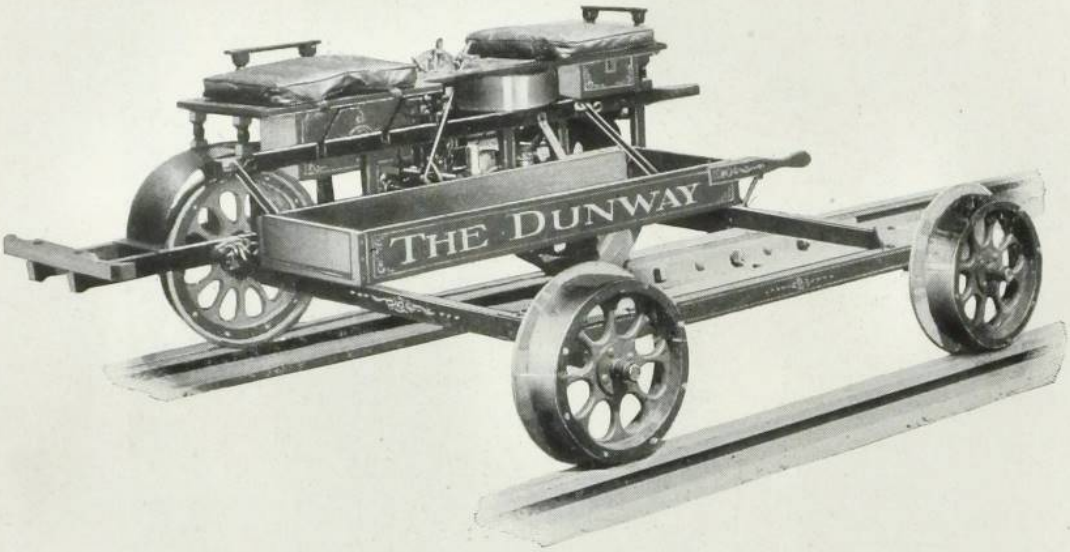
Code Word—"HARTLEY"



The construction of this car is the "four-wheel" type, which we consider is the only correct principle upon which to build a safe car. The car is designed to carry four passengers. It is substantially constructed throughout, none but the best material and workmanship being employed, and is strong, safe and durable. The engine and all working parts are under the platform; the removal of a detachable section of the platform directly over the motor gives free access to all parts of the machinery; all parts are interchangeable. Let us tell you more about this car.

Gasoline Motor Car No. 1

Direct Connected. **For Two Persons.**



Code Word—"DUNWAY"

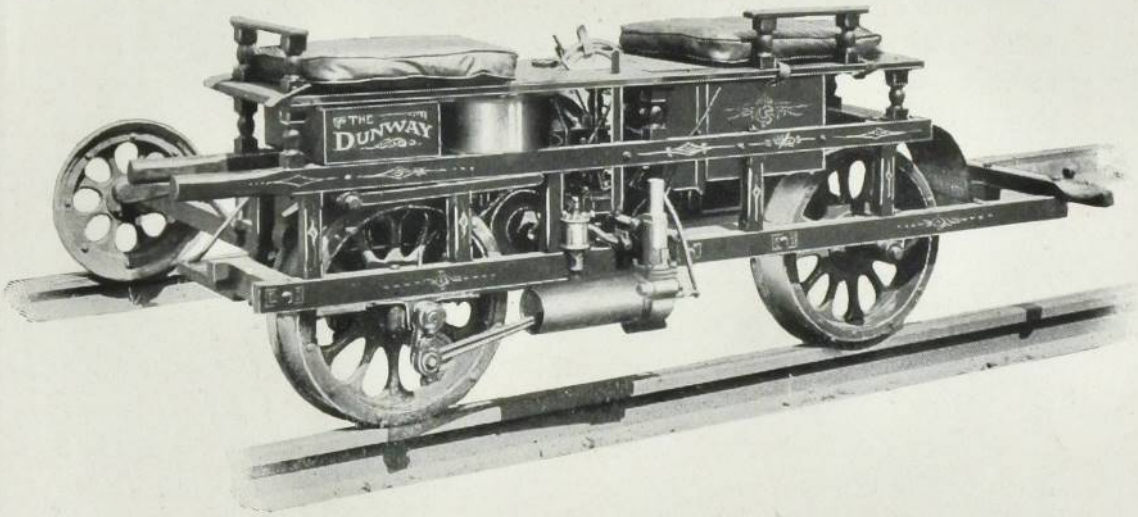
Special Features of Our Car

Our No. 1 four wheel car is equipped with a 4 cycle, 2 cylinder engine developing 3 horse-power. By the use of the jump spark, and our *Non-Atmospheric Carburetor* we obtain the following results :

A car that will *always start within one rail length ;* its speed may be regulated from 3 to 30 miles per hour Owing to its simplicity all parts are easily accessible, any one piece can be removed without disturbing any other part. *All parts are interchangeable.* The car is constructed in *two parts* the same being *detachable*, that is, by the removal of four pins, the tray and guide wheels can be detached from the engine or main part, an operation that requires only a few minutes' time This permits it being carried on trains.

Gasoline Motor Car No. 1

Direct Connected. **For Two Persons.**



Code Word—"DUNWAY"

In presenting this Motor Car to the railroad companies, we can say to them that it is so simple in its construction that any one can operate it. The parts are all made strong and durable. It will be found invaluable on inspection, and is an ideal car for telegraph line men.

Cars are furnished with wood center, or insulated steel wheels. The car can be readily placed on or off the track by one person. Upon request, we will gladly refer you to persons using our cars.

Write us for prices.

The Committee on Track Jacks appointed by the Roadmasters' Associations of America, in 1902, reported, in part, as follows:

* * "The Track Jacks that give the best results to-day, are the ones that do the work the quickest, that is: will raise the track safely and accurately and release quickly. Track Jacks are subjected to different kinds of track work. In yards, around switches and frogs, the work which Track Jacks are subjected to is, perhaps, heavier than elsewhere, consequently the strongest and most reliable Jack, even though not as quick as others, would be satisfactory." * *

"For general track repairs, a light, handy Jack, one that one man can handle, would be satisfactory, and most suitable for the surfacing of tracks, and should be so designed as to be carried conveniently by one man, in order to get on with the required surfacing of track, and should be so constructed that the track could be raised the required height." * *

"For general track repairs, we would recommend a Jack not exceeding 65 pounds in weight, and we think that the * * * * No. 1 TRACK JACK is the best for this work that we know of. * *

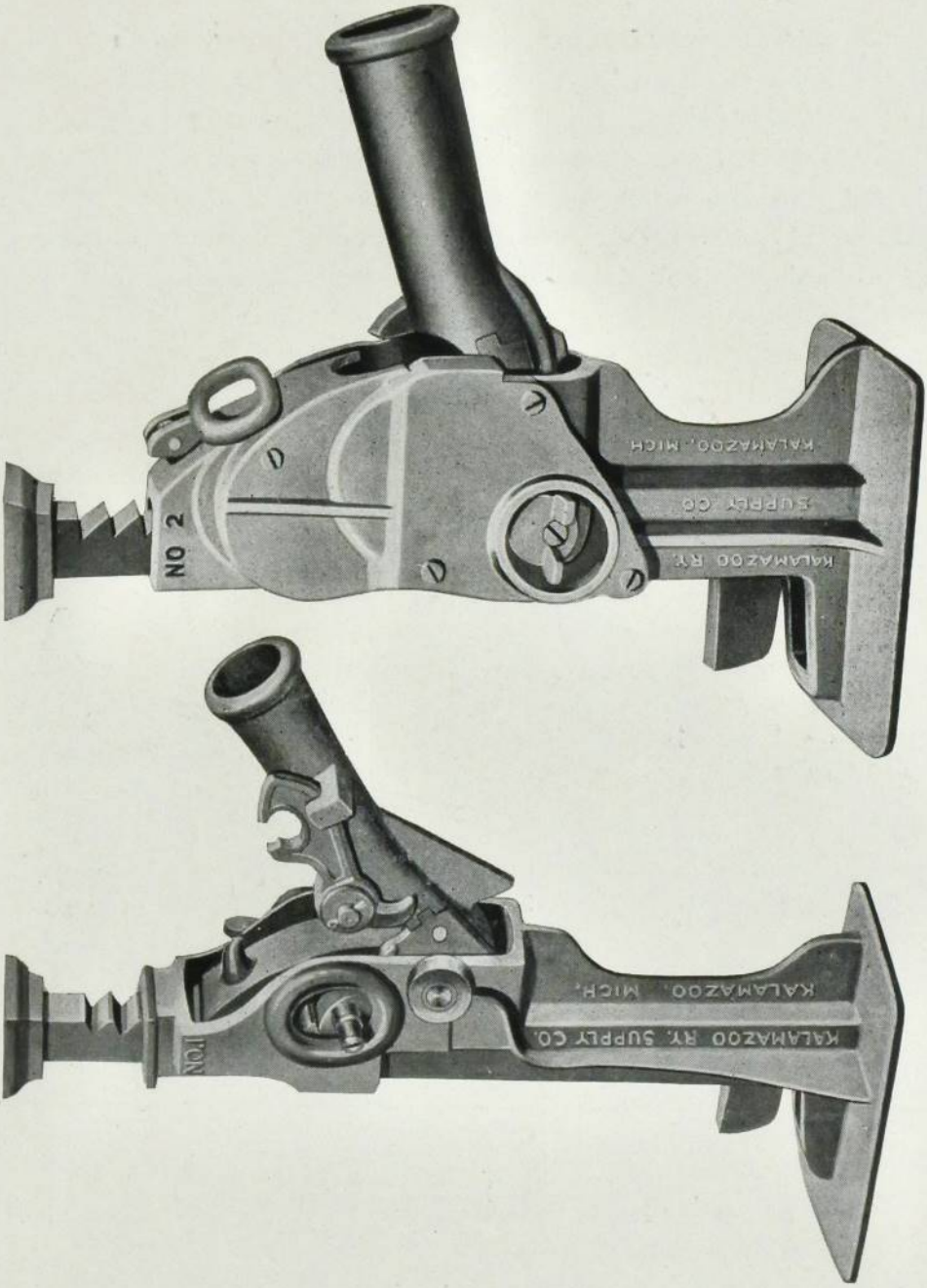
T. HICKEY,
D. E. CROWLEY,
A. M. HAWKINS,
T. J. MCCLOSKEY,
COMMITTEE.

GUARANTY

We Fully Guarantee the materials and workmanship in Kalamazoo Ratchet Jacks and Friction Jacks, also the lifting capacity up to the limit specified.

We furthermore assure all purchasers and users of Kalamazoo Ratchet and Friction Jacks that no patents are infringed, and that there are no restrictions whatever to the free manufacture, sale and use of these appliances.

Kalamazoo Ratchet Jacks



No. 2 Automatic Lowering Jack

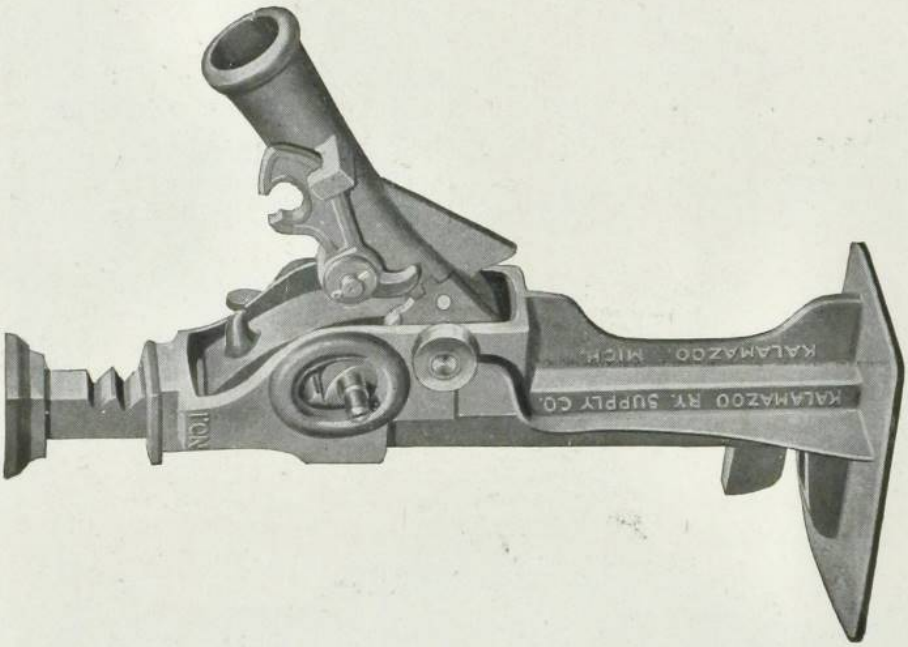
No. 1 Tripping Track Jack

Are the most desirable track, bridge, and car lifting Jacks on the market. Their practical merit has been demonstrated during 25 years to almost every railroad maintenance man in America.

Best distribution of metals to withstand strains; correct shape and dimensions; choicest materials and workmanship employed in their manufacture; interchangeability of parts with similar jacks of other make—are some of the superior features of construction of Kalamazoo Jacks.

No. 1. Tripping Track Jack

A first-class compound lever, double acting jack, raising load a half notch on both up and down strokes. Is very quick and positive acting. Load may be instantly dropped from any elevation. Lifting capacity up to ten tons guaranteed. Designed and intended for a track jack and should be so used exclusively. Meets all the requirements set forth in recommendation of Committee of Roadmasters' Association of America.

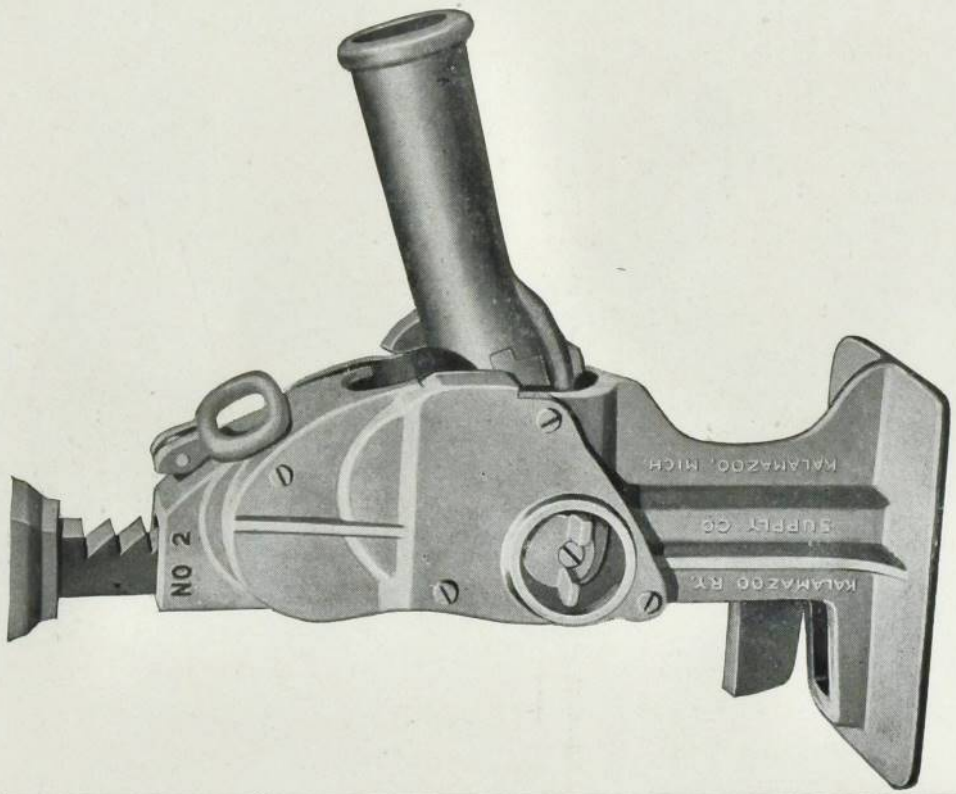


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	24	13½	37½	1½ x 1½	62	*Antelope*	$18 00

For List of Parts of this Jack see Page 86

No. 2. Automatic Lowering Jack

Designed and intended for general lifting. May be applied in car barn, power house, viaduct and bridge, as well as track work; also in clearing wrecks and lifting machinery. Is an all-round serviceable tool. Should be carried on every trolley and cable car, for quick emergency use. It is compound lever, double-acting, moving load up or down at each stroke of the lever, direction of motion being changed by the thumb eccentric in side of frame. Jack operates at any angle.

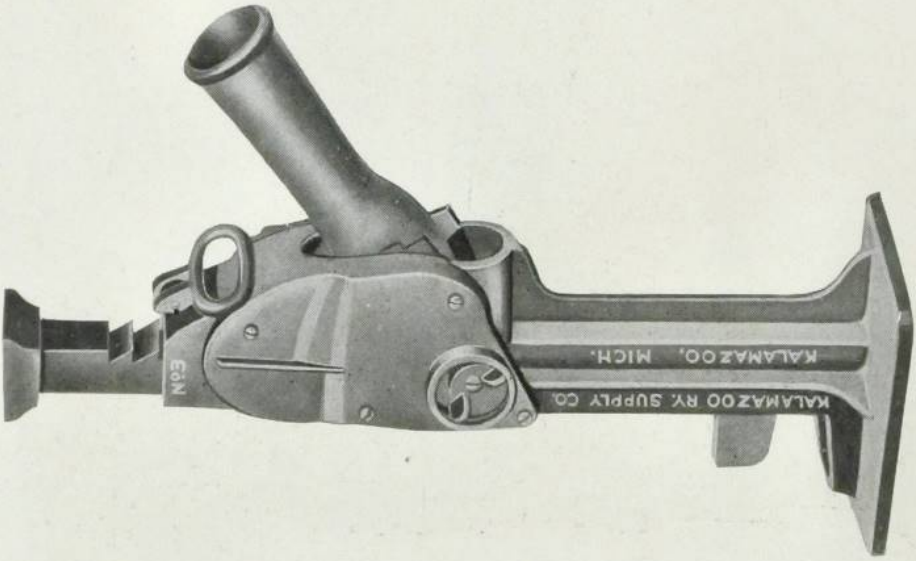


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	21	10	31	$1\frac{5}{8}$ x $1\frac{1}{2}$	65	*Beaver*	$25 00

For List of Parts of this Jack see Page 87

No. 3. Automatic Lowering Jack

This is a larger and more powerful modification of design No. 2, described on previous page. Observe it is much taller and is better calculated to raise, to any considerable height, car bodies, machinery and other loads. Jack will operate at any angle. Remember, in selecting, to get tools heavy enough for the intended service.

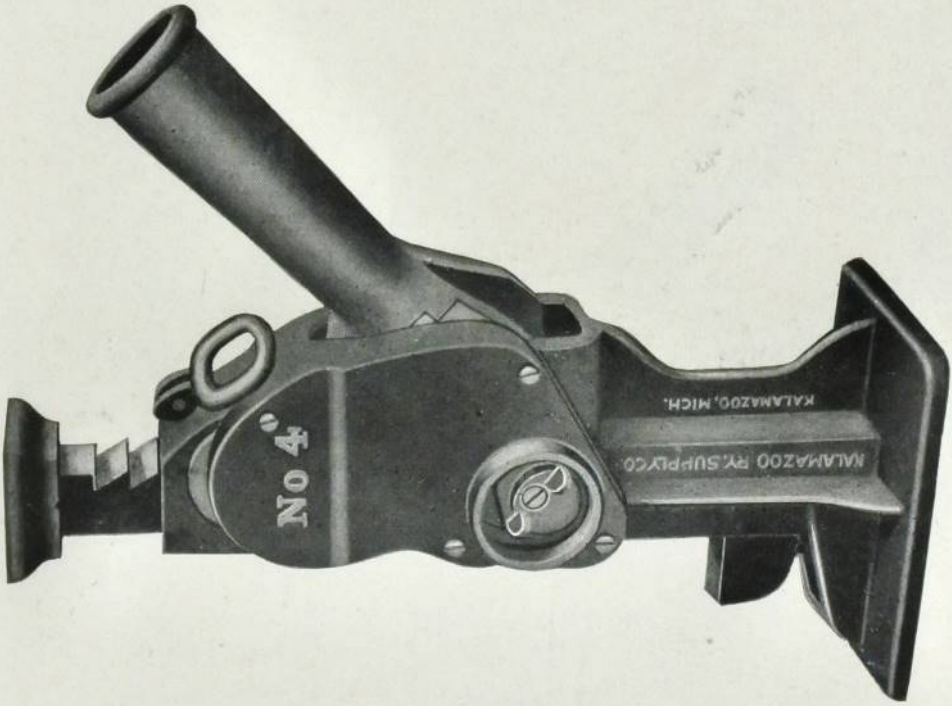


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
12	26½	15	41½	1⅜ x 1⅞	85	*Caribou*	$30 00

For List of Parts of this Jack see Page 87

No. 4. Automatic Lowering Jack

Smaller in design to No. 2, but rated 50 per cent more capacity. Stoutness is depicted in the short, thick-set frame, with ribs or fins to reinforce. This is a first-class, all-round servicable jack for handling the heavier loads, yet is easily portable by means of the carrying handle conveniently located. It is compound lever, double-acting, moving load on both upward and downward stroke of the lever, direction being controlled by thumb eccentric shown at the side of frame. Will operate at any angle.

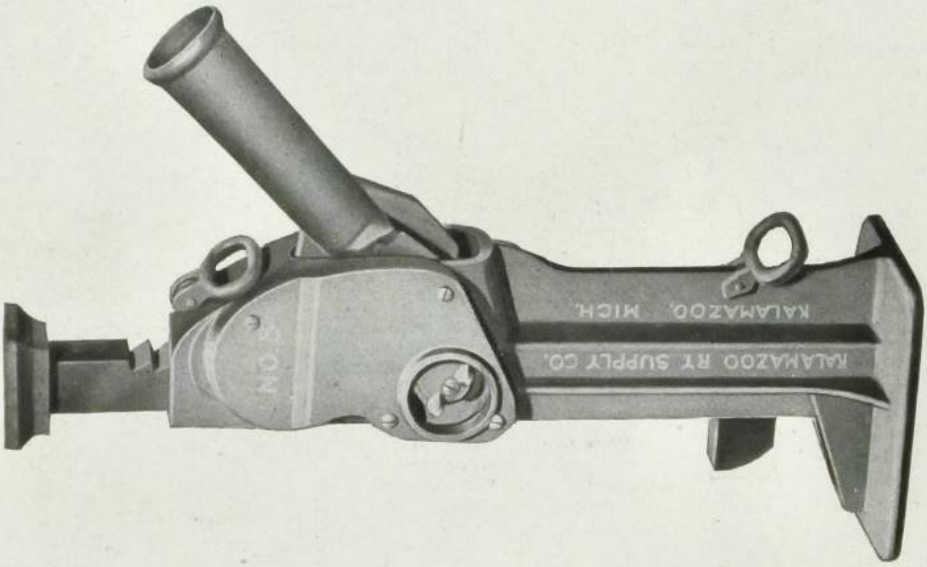


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
15	22	10	32	2 x 2	100	*Donkey*	$35 00

For List of Parts of this Jack see Page 87

No. 5. Automatic Lowering Jack

Tallest and heaviest jack of the class. Designed to reach high- as well as low-set loads. Car bodies may be lifted by the upper end of the raising rack. On the other hand, machinery or track may be raised by the lug at the base. This is a double-acting jack, and the reversal of motion is effected by a turn of the thumb eccentric shown at the side of frame. Select this jack for your heavy work, rather than overload and take chance of accident with a weaker tool. Jack operates at any angle.

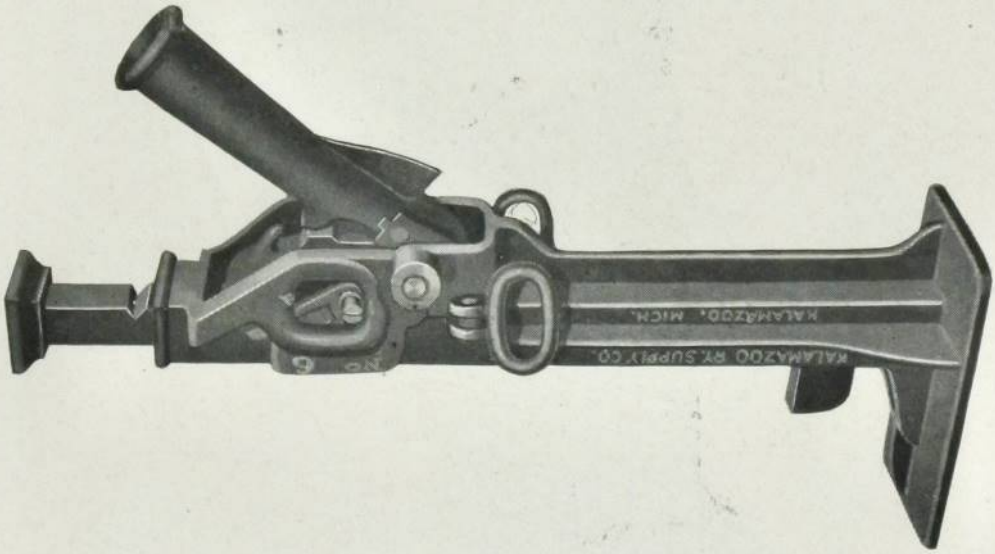


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
15	28	15	43	2 x 2	115	*Elk*	$40 00

For List of Parts of this Jack see Page 87

No. 6. Tripping Track Jack

Designed for **ballasting** gangs; is very powerful, tall, and high lifting. Will raise fifteen ton load nineteen inches. Just the thing for track elevating and ballasting service. Is double-acting, compound lever, safe against accidental precipitation of load. At the same time, a trip affords the means to instantly drop the load from any elevation at will of operator. Jack is designed and intended only for heavy track work, such as elevating and ballasting, as stated.



Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
15	31	19	50	$1\frac{7}{8}$ x $1\frac{5}{8}$	105	*Ferret*	$32 00

For List of Parts of this Jack see Page 88

No. 8. Automatic Oil Box Jack

This is the most successful oil box jack for car departments of steam and electric railways. Specimen should be carried as part of the equipment of every locomotive. Is put up in a very small compass, yet has a lifting capacity to ten tons. It is double-acting, compound lever, safe against failure to the injury of limbs. The direction of motion upward and downward is controlled by the thumb eccentric at lower left side of frame. Operates at any angle.

Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	11	5	16	$1\frac{5}{8}$ x $1\frac{1}{2}$	48	*Gorilla*	$22 00

For List of Parts of this Jack see Page 89

No. 12. Tripping Track Jack

A shorter and lighter jack, designed similarly to the No. 1. Is recommended for ordinary track over-hauling, where the lift limit is short. Is a compound lever, double-acting jack, raising load on both upward and downward strokes of lever. Load tripped from any height within its range at will of operator.

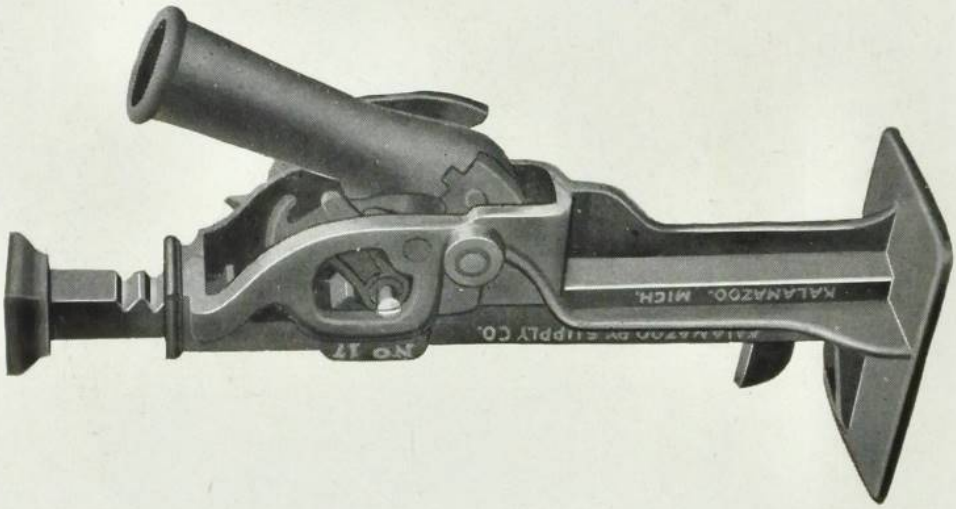
Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	17⅞	8	25⅞	1½ x 1½	50	*Hyena*	$17 00

For List of Parts of this Jack see Page 86

No. 17. Tripping Track Jack

Single-Acting

A single-acting jack, lifting a full notch on only the down stroke of the lever: Load may be precipitated from any height at will of operator, by means of trip. This jack is designed to meet the preference of some maintenance of way engineers, for a single-acting instead of double-acting jack. It is intended for track work exclusively.



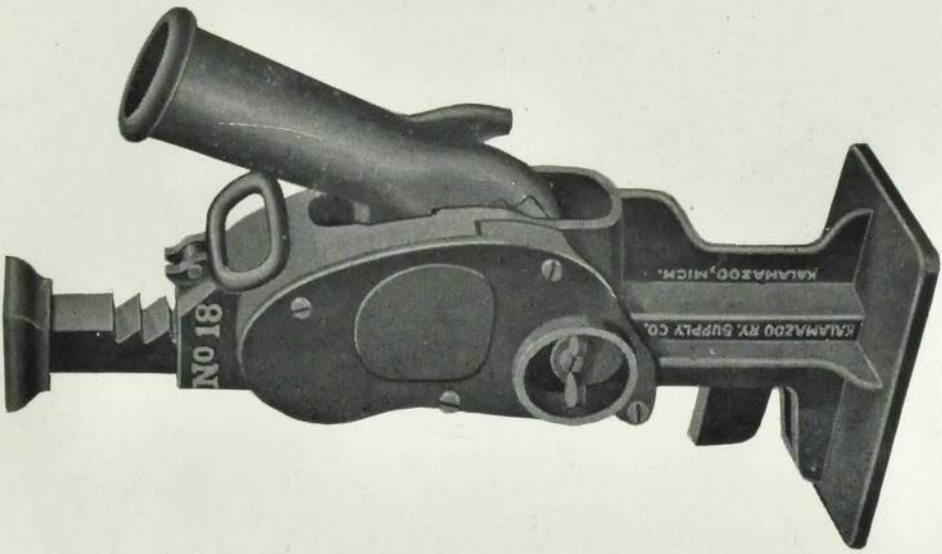
Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	24	13⅜	37⅜	1½ x 1½	63	*Leopard*	$18 00

For List of Parts of this Jack see Page 90

No. 18. Automatic Lowering Jack

Single-Acting

This Jack is the same size and capacity as the No. 2, but single-acting—that is: raises and lowers load only on down stroke of lever, direction of operation being controlled by the eccentric on side of frame. It is especially desirable for track and bridge work, as the operation is safe, swift and easy. Operates at any angle.



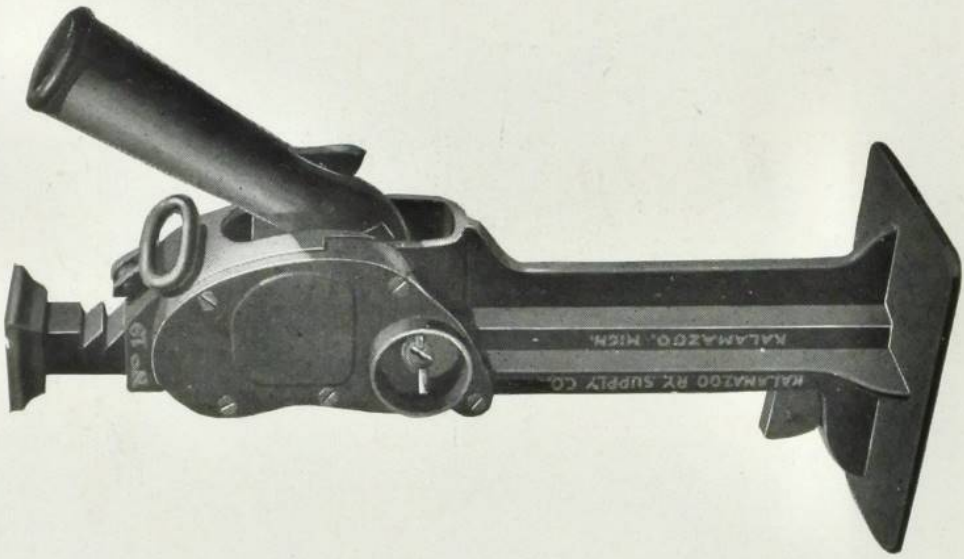
Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
10	21	10	31	$1\frac{1}{2} \times 1\frac{5}{8}$	68	*Ibex*	$25 00

For List of Parts of this Jack see Page 91

No. 19. Automatic Lowering Jack

Single-Acting

Intended for car repairing, and is rapidly supplanting hydraulic and screw jacks for empty cars and those lightly loaded. Easy to handle; not liable to get out of order; cheaply operated; of good height for lifting cars and has a foot on rack for low-set loads. Single-acting, raising and lowering load on down stroke of lever. Direction for operation is controlled by the eccentric on side of frame. Operates at any angle.



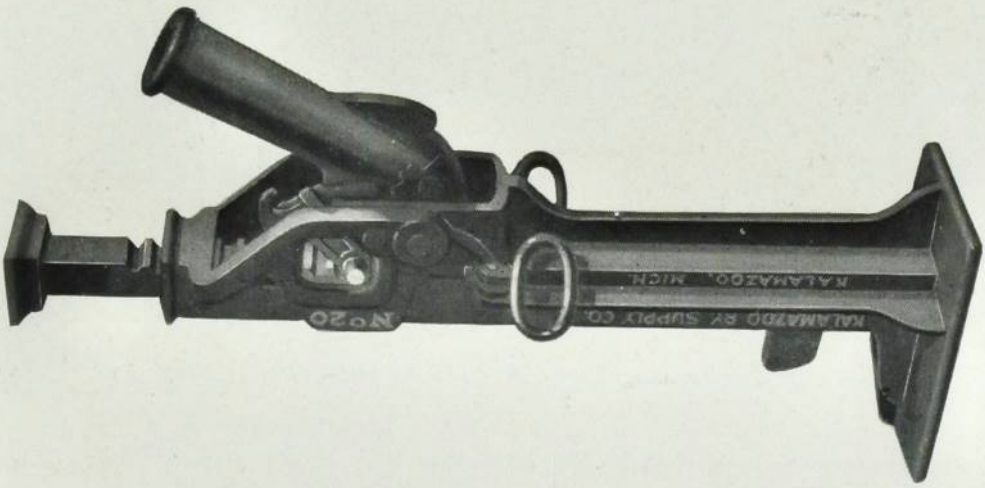
Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
15	28	17½	45½	2 x 2	102	*Jaguar*	$35 00

For List of Parts of this Jack see Page 91

No. 20. Tripping Track Jack

Single-Acting

A single-acting jack, lifting only on the downward stroke of the lever. Is the choice of a considerable number of practical trackmen, and designed to meet the call for a strong and powerful jack. It is intended particularly for ballasting and track elevating gangs. The standard is thirty-one inches high, and the load may be run up nineteen inches more; thus it is peculiarly fitted for the service intended Load may be precipitated at will of operator from any height by means of the trip. We do not recommend this jack for other than track work.

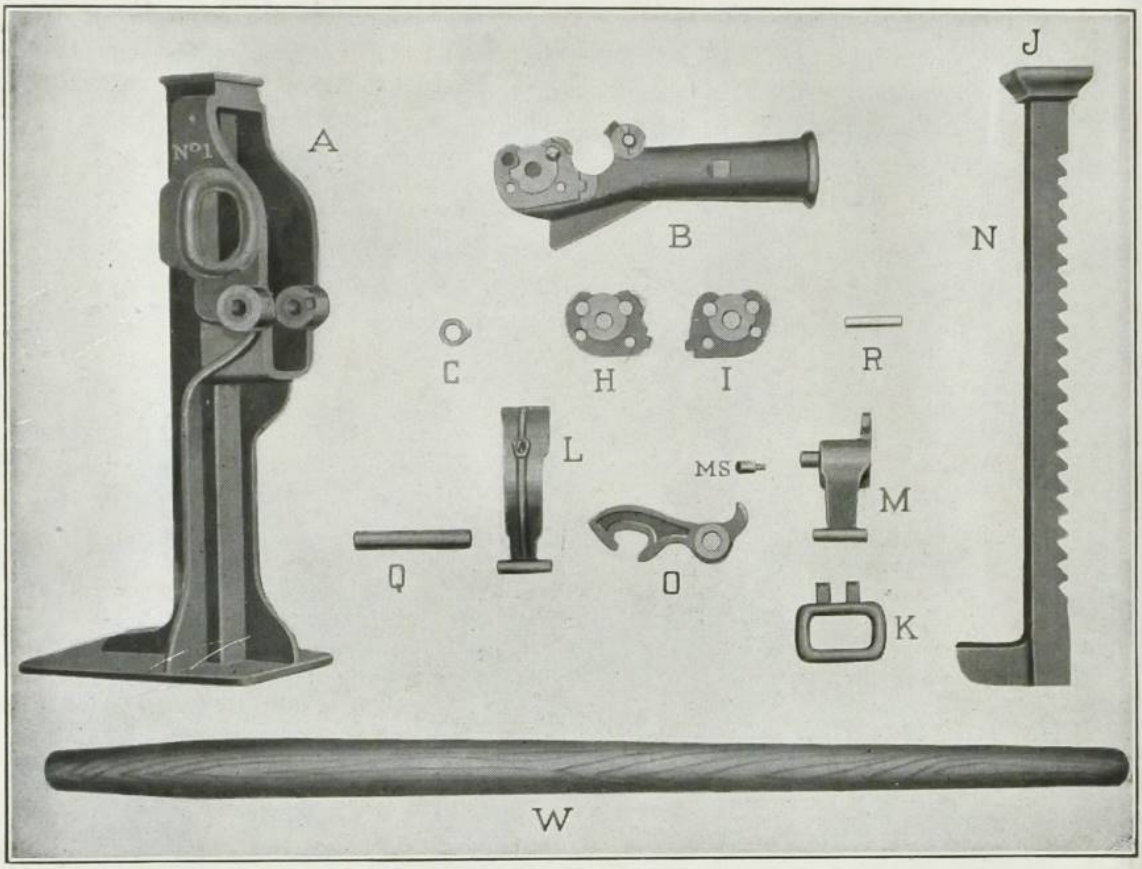


Capacity in Tons	Height, Bar Down, Inches	Raise of Bar Inches	Height, Bar Raised, Inches	Size of Bar Inches	Weight Pounds	Code Word	List Price
15	31	19	50	$1\frac{5}{8}$ x $1\frac{7}{8}$	106	*Moose*	$32 00

For List of Parts of this Jack see Page 90

Price List

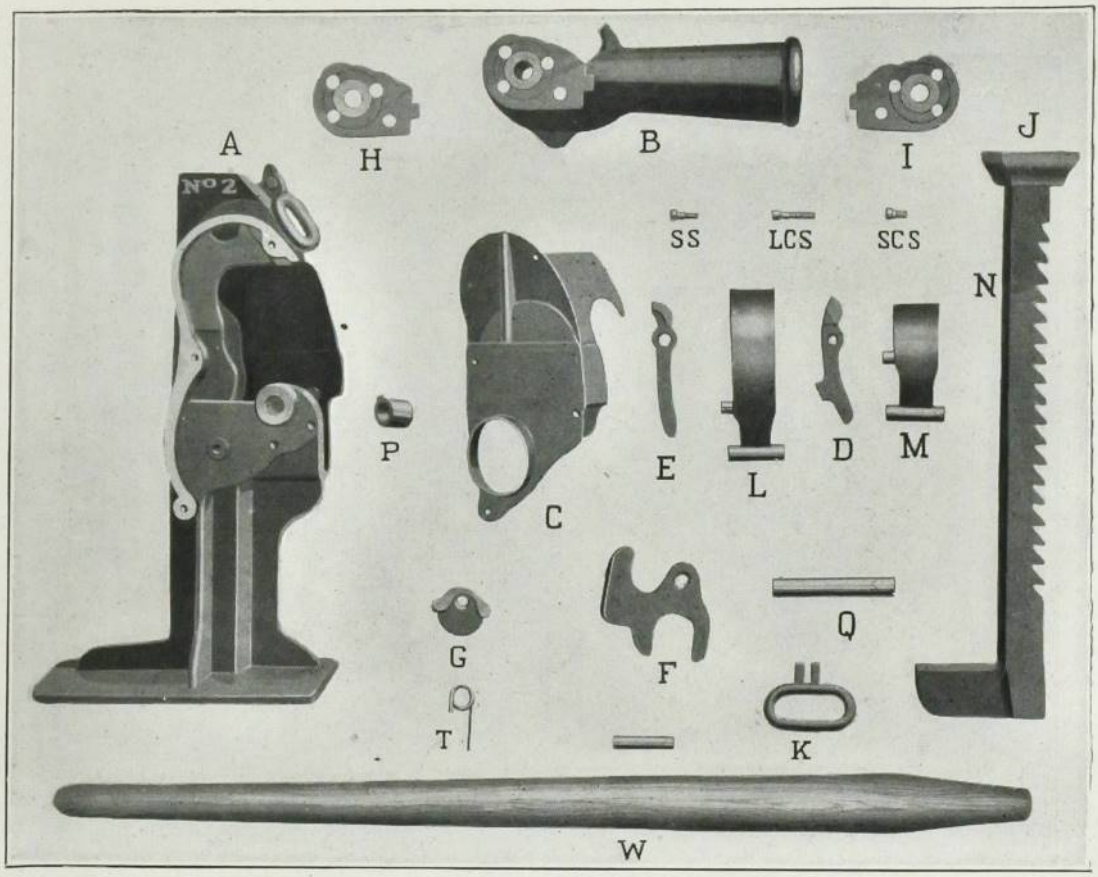
Parts of Nos. 1 and 12 Tripping Track Jacks



Symbol	Description	No. 1	No. 12
A	Base with bushings	$7 50	$6 75
B	Socket lever with side plates	3 00	3 00
C	Bushing (2) each	20	20
H	Right hand side plate	30	30
I	Left hand side plate	30	30
J	Top of rack	30	30
K	Carrying handle	20	20
L	Long Pawl	1 50	1 50
M	Short Pawl	1 50	1 50
N	Steel Rack	4 50	4 00
O	Trip	50	50
Q	Fulcrum Pin	30	30
R	Side plate rivet (2) each	05	05
MS	Short pawl screw	10	10
W	Wood Handle	30	30

Price List

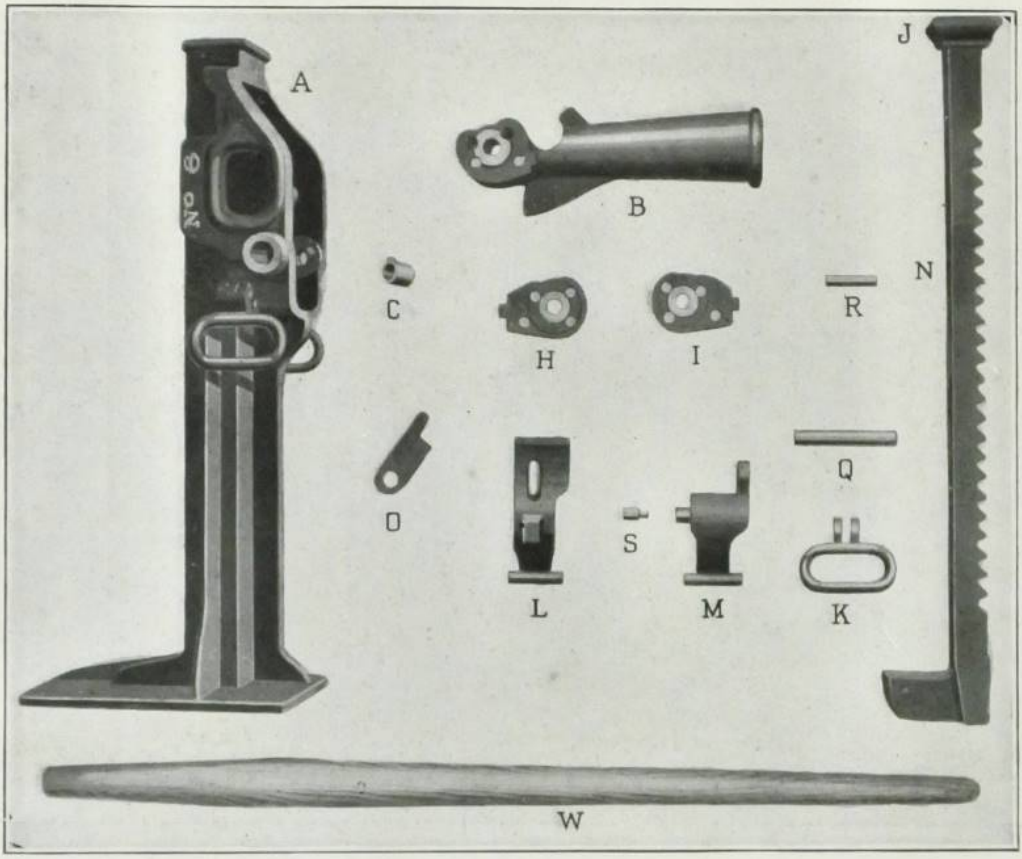
Parts of Nos. 2, 3, 4, and 5 Automatic Lowering Jacks



Symbol	Description	No. 2	No. 3	No. 4	No. 5
A	Base with bushings and handle	$10 00	$12 50	$13 50	$16 00
B	Socket lever with side plates	3 50	3 50	4 50	4 50
C	Shield	90	90	1 00	1 00
D	Short pawl spring lever	30	30	30	30
E	Long pawl spring lever	30	30	30	30
F	Lowering block	80	80	90	90
G	Eccentric	30	30	30	30
H	Right hand side plate	30	30	30	30
I	Left hand side plate	30	30	30	30
J	Top of rack	30	40	70	70
K	Carrying handle	20	20	20	20
L	Long pawl	1 60	2 00	2 00	2 00
M	Short pawl	1 60	1 70	1 80	1 80
N	Steel Rack	5 00	8 50	9 00	10 00
P	Bushing (2) each	20	20	20	20
Q	Fulcrum pin	30	30	35	35
R	Side plate rivet (2) each	05	05	05	05
T	Spring (2) each	10	10	10	10
W	Wood handle	35	40	50	50
SS	Shoulder screw (4) each	10	10	10	10
SCS	Short shield screw (3) each	08	08	08	08
LCS	Long Shield screw	10	10	10	10

Price List

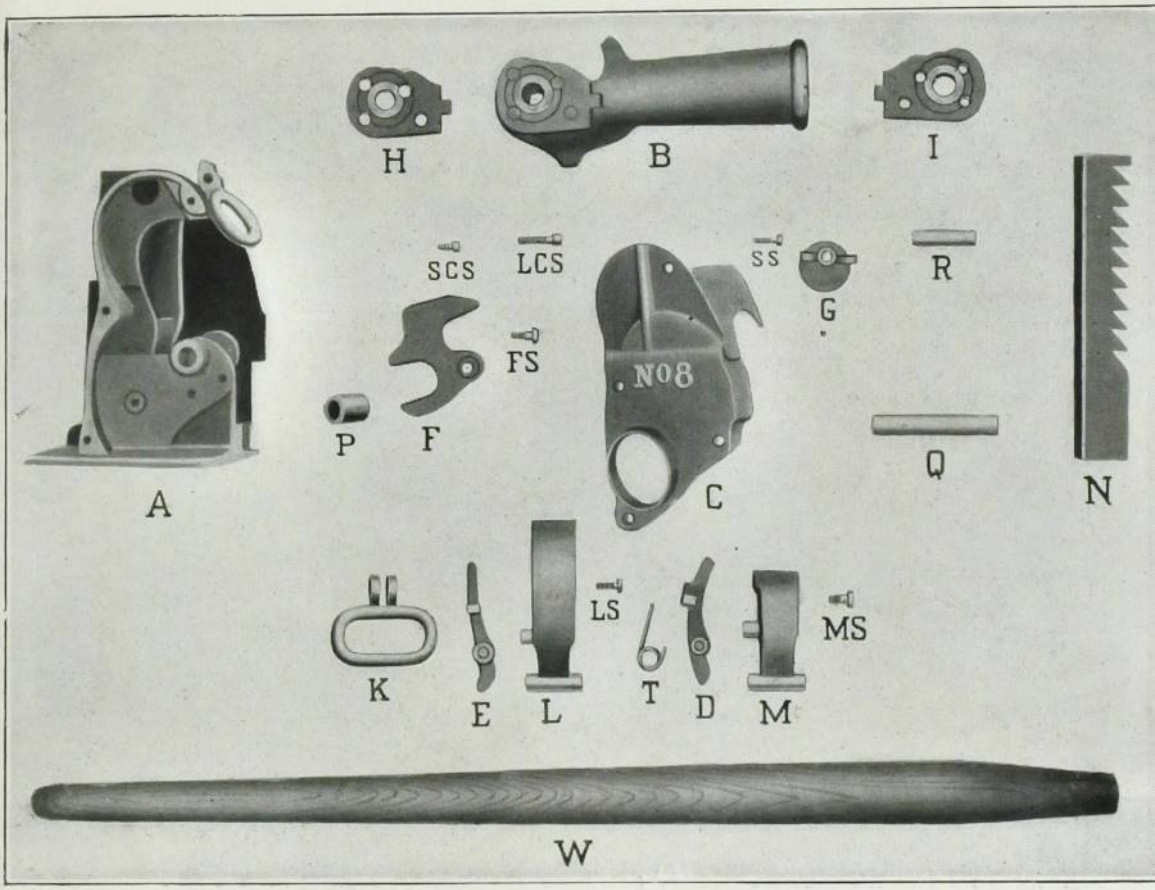
Parts of No. 6 Tripping Track Jack



Symbol	Description	
A	Base with bushings and handles	$16 00
B	Socket lever with side plates	3 75
C	Bushing (2) each	20
H	Right hand side plate	30
I	Left hand side plate	30
J	Top of rack	60
K	Carrying handle (2) each	30
L	Long pawl	2 00
M	Short pawl	2 00
N	Steel rack	9 00
O	Trip	45
Q	Fulcrum pin	40
R	Side plate rivet (2) each	05
S	Short pawl screw	10
W	Wood handle	40

Price List

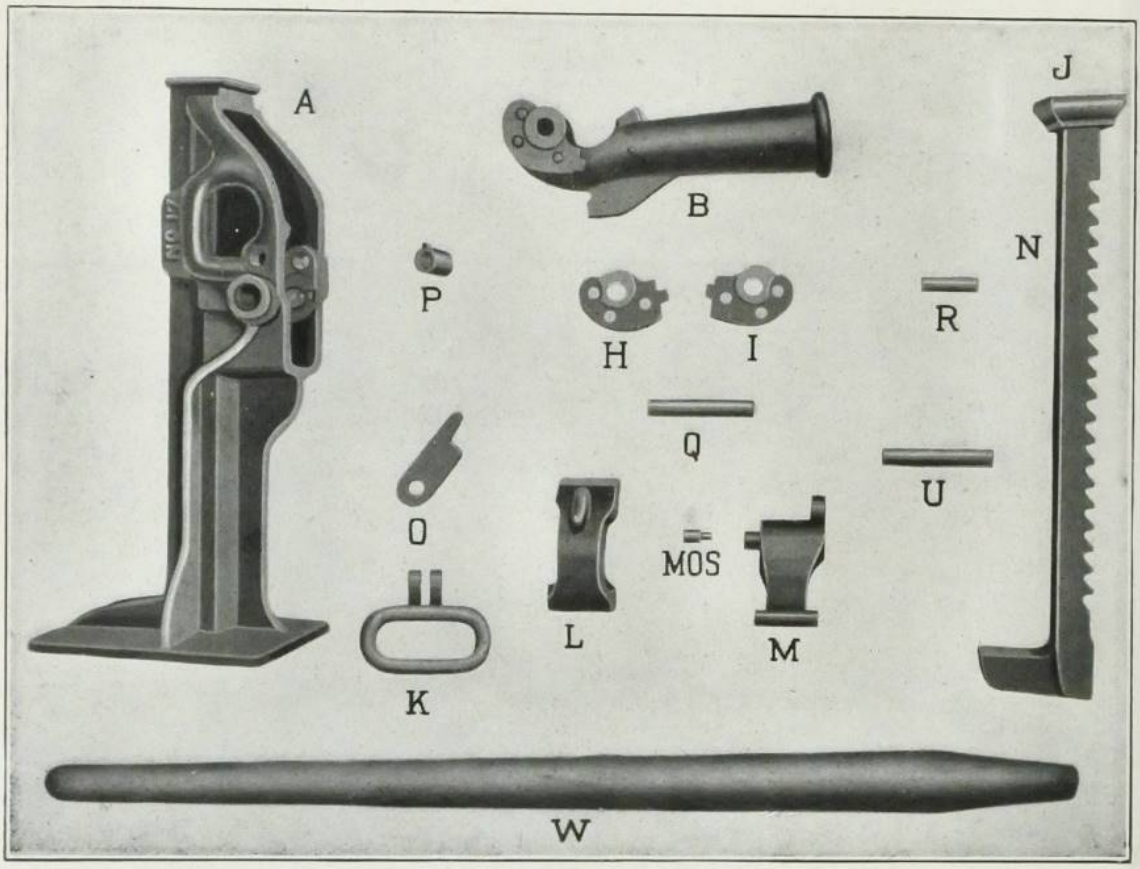
Parts of No. 8 Automatic Lowering Jack



Symbol	Description	
A	Base with bushings and handle	$9 00
B	Socket lever with side plates	3 50
C	Shield	90
D	Short pawl spring lever	30
E	Long pawl spring lever	30
F	Lowering block	80
G	Eccentric	30
H	Right hand side plate	30
I	Left hand side plate	30
L	Long pawl	1 60
M	Short pawl	1 60
N	Steel rack	2 00
K	Carrying handle	20
P	Bushing (2) each	20
Q	Fulcrum pin	30
R	Side plate rivet (2) each	05
T	Spring (2) each	10
W	Wood handle	35
SS–FS–LS–MS	Shoulder screw each	10
SCS	Short shield screw (3) each	08
LCS	Long shield screw	10

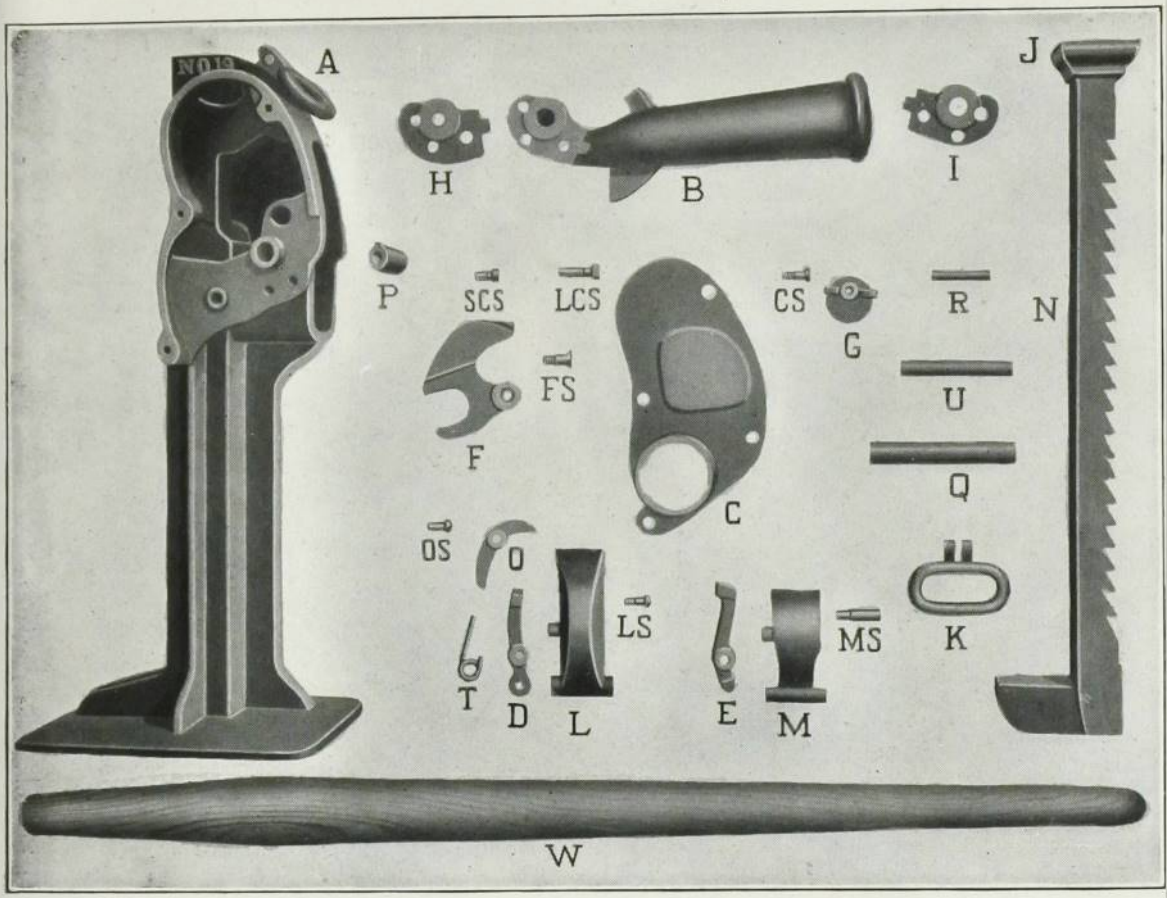
Price List

Parts of Nos. 17 and 20 Tripping Track Jack



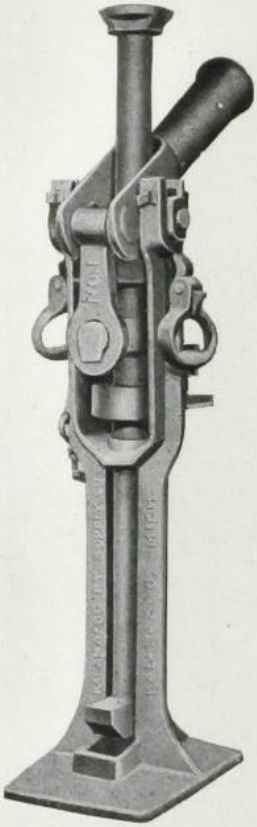
Symbol	Description	No. 17	No. 20
A	Base with bushings and handle	$7 50	$15 00
B	Socket lever with side plates	3 00	3 50
H	Right hand side plate	30	30
I	Left hand side plate	30	30
J	Top of rack	30	60
K	Carrying handle	20	30
L	Long pawl	1 50	2 00
M	Short pawl	1 50	2 00
N	Steel rack	4 50	9 00
O	Trip	45	40
P	Bushing (2) each	20	20
Q	Fulcrum	30	40
R	Side plate rivet (2) each	05	05
U	Long pawl pin	25	30
W	Wood handle	35	40
MOS	Short pawl screw	10	10

Price List of Parts of Nos. 18 and 19 Automatic Lowering Jack



Symbol	Description	No. 18	No. 19
A	Base with bushings and handle	$10 00	$15 00
B	Socket lever with side plates	3 50	3 50
C	Shield	1 00	1 00
D	Short pawl spring lever	30	30
E	Long pawl spring lever	30	30
F	Lowering block	80	80
G	Eccentric	30	30
H	Right hand side plate	30	30
I	Left hand side plate	30	30
J	Top of rack	30	70
K	Carrying handle	20	20
L	Long pawl	1 80	1 80
M	Short pawl	1 60	1 65
N	Steel rack	5 00	9 25
O	Auxiliary lever	20	20
P	Bushing (2) each	20	20
Q	Fulcrum pin	30	35
R	Side plate rivet (2) each	05	05
T	Spring (2) each	10	10
U	Pawl pin	25	30
W	Wood handle	35	40
OS	Auxiliary lever screw	10	10
SCS	Short shield screw (3) each	08	08
LCS	Long shield screw	10	10
LS	Long pawl screw	10	10
MS	Short pawl screw	10	10
GS	Eccentric screw	10	10
FS	Lowering block screw	10	10

Kalamazoo Jenne Friction Jacks



No. 1

No. 2

Steel pivots, bronze boxes, malleable iron frame and lever socket, wrought iron rings, hanger and lifting bar.

Suggestions

Should lifting bar become oily, burn it off or scour it off with coal ashes or sand. If bar is frosty, burn it off with paper. To dismantle jack for repairs, unscrew bar cap.

Kalamazoo Jenne Friction Jacks

No. 0 For raising low joints, and light track repairs. 27 in. high with bar down; 10 in. lift; lifting bar, 1¼ in. diameter; weight, 40 lbs. Price.... $16 00

Code Word—"QUAIL"

No. 1 For surface and track repairs. 31 in. high with bar down; 12 in. lift; lifting bar, 1½ in. diameter; weight, 60 lbs. Price..... $20 00

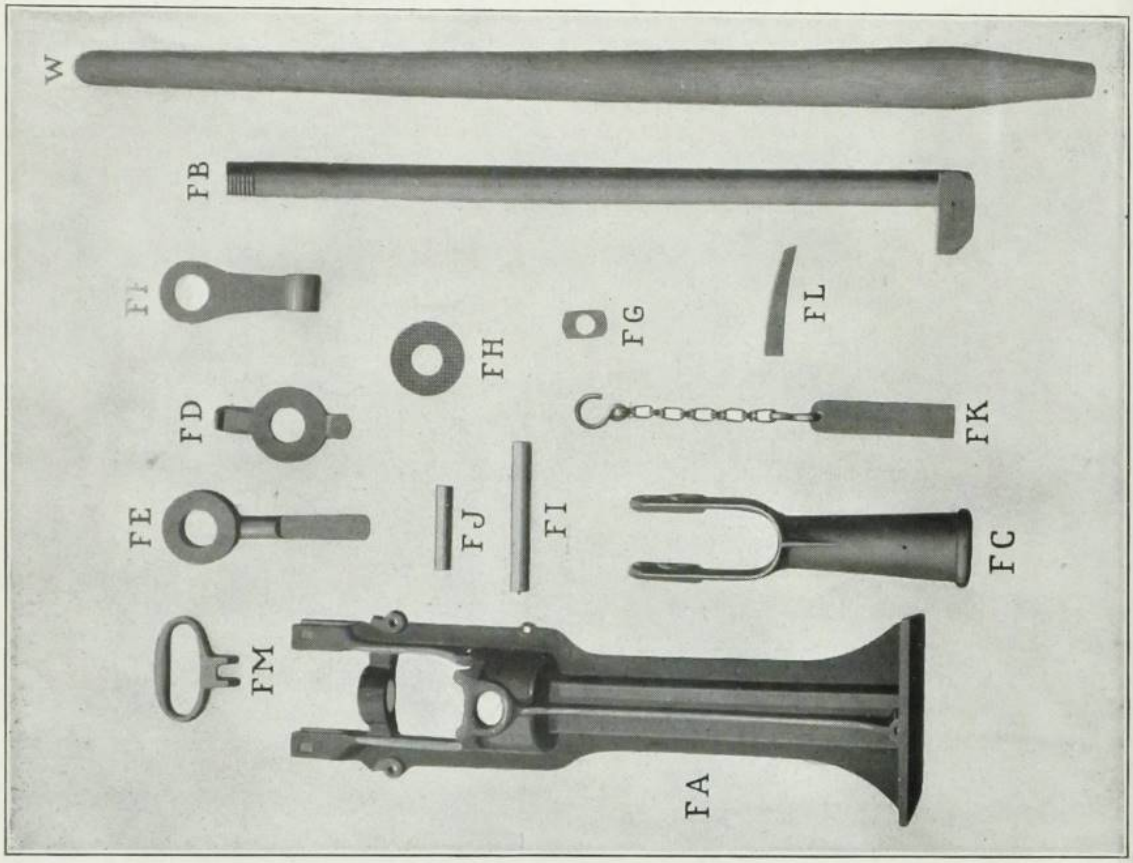
Code Word—"HERON"

No. 2 For heavy ballasting, surfacing, and general track repairs. 35 in. high with bar down; 15 in. lift; lifting bar, 1¾ in. diameter; weight, 90 lbs. Price..... $24 00

Code Word—"FALCON"

Price List

Parts of Jenne Friction Jacks



Symbol	Description	No. 1	No. 2
FA	Base or stand	$7 00	$10 00
FB	Lifting bar	1 50	2 00
FC	Lever socket	2 00	2 50
FD	Upper lifting ring	1 00	1 25
FE	Lower lifting ring	1 00	1 25
FF	Hanger	75	1 00
FG	Bronze boxes, per pair	90	1 00
FH	Lifting bar cap	40	50
FI	Steel fulcrum pin	40	50
FJ	Hanger pin	30	40
FK	Trip latch with chain	40	50
FL	Split keys, per pair	30	40
FM	Malleable handle	40	50

Better to always order lever socket with hanger and steel pins complete, as exact fit is then assured. Repairs promptly supplied from stock.

Dimensions and Prices of

Kalamazoo Ratchet Jacks

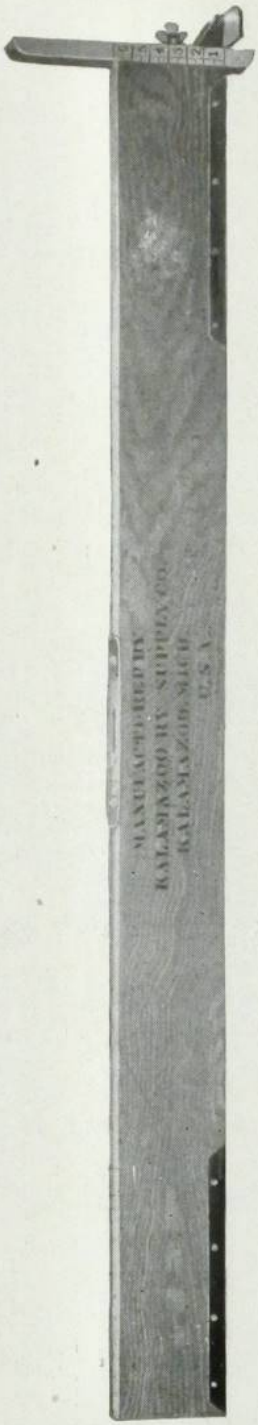
No.	Height, Bar Down, Inches	Raise of Bar, Inches	Height, Bar Raised, Inches	Size of Bar, Inches	Weight Pounds	Cap'cty Tons	Code Word	List Price
1 trip	24	13½	37½	1½ x 1½	62	10	*Antelope*	$18 00
6 "	31	19	50	1⅞ x 1⅝	105	15	*Ferret*	32 00
12 "	17¾	8	25¾	1½ x 1½	50	10	*Hyena*	17 00
*17 "	24	13¾	37¾	1½ x 1½	63	10	*Leopard*	18 00
*20 "	31	19	50	1⅝ x 1⅞	106	15	*Moose*	32 00
2 A. L.	21	10	31	1⅝ x 1½	65	10	*Beaver*	25 00
3 "	26½	15	41½	1¾ x 1⅞	85	12	*Caribou*	30 00
4 "	22	10	32	2 x 2	100	15	*Donkey*	35 00
5 "	28	15	43	2 x 2	115	15	*Elk*	40 00
8 "	11	5	16	1⅝ x 1½	48	10	*Gorilla*	22 00
*18 "	21	10	31	1⅝ x 1½	68	10	*Ibex*	25 00
*19 "	28	17½	45½	2 x 2	102	15	*Jaguar*	35 00

Jacks marked (*) are single-acting; all others are double-acting.

Dimensions and Prices of

Jenne Friction Jacks

Page	No.	Height, Bar Down, Inches	Raise of Bar, Inches	Height, Bar Raised, Inches	Size of Bar, Inches	Weight Pounds	Code Word	List Price
92	0	27	10	37	1¼	40	*Quail*	$16 00
92	1	31	12	43	1½	60	*Heron*	20 00
92	2	35	15	50	1¾	90	*Falcon*	24 00



Kalamazoo Adjustable Track Level

Patented

Code Word—"KALADEL"

Simple
Accurate
Durable

Malleable iron elevation beam, channel shape, guarantees proper position of level and bearing plate at all times.

The plain scale of figures insures accurate adjustment to any desired elevation up to six inches.

A 1½ x 6-inch bearing plate near lower end of elevation beam supports level and prevents it falling sidewise.

The elevation beam projects 1¼ inches below bottom of bearing plate, which it guides to position, and prevents slipping outward from top of rail.

Spirit vial has adjustable dial or guard plate, simple and effective, whereby inaccuracies may be easily corrected.

Metal wear plates are provided where level contacts with rails.

Board of best white pine, superior for the purpose to hardwood.

Common Track Level

Code Word—"COMLEL"

Railroads having their own standards, we will be pleased to quote them prices on them.

Huntington Track Gauge

Code Word—"HUNTAGE"

Caffrey-Huntington Track Gauge

Code Word—"CAFAGE"

With guard rail attachment. Shows proper distance at which to set guard rail.

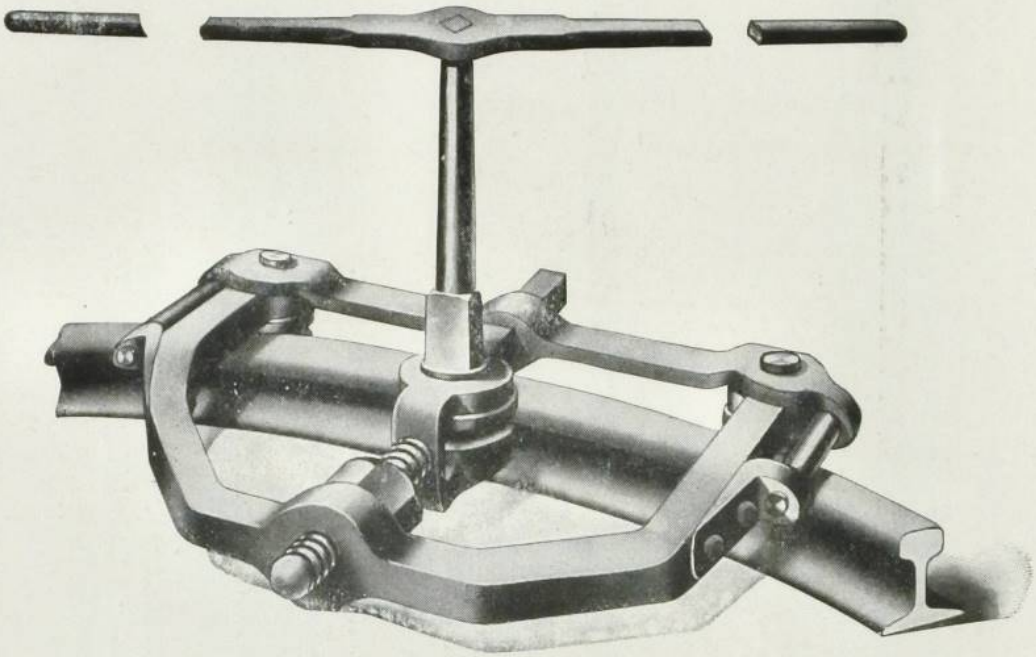
Kalamazoo Insulated Track Gauge

Code Word—"KALAGE"

With radial ends.

Railroads having their own standards, we will be pleased to quote them prices on them.

Roller Rail Bender and Straightener

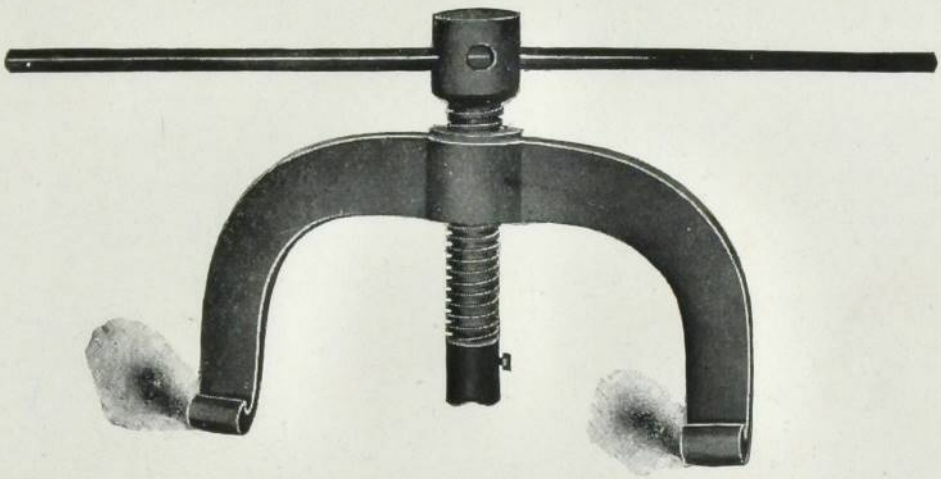


Applied as illustrated, then made to run over rail rapidly by turning lever at top of standard. Adjustable to the degree of curvature. Rails precisely bent without kinks or breakage of grain. Besides bending rails it is useful in truing up old and imperfect curves.

Always send tracing of rail section with order

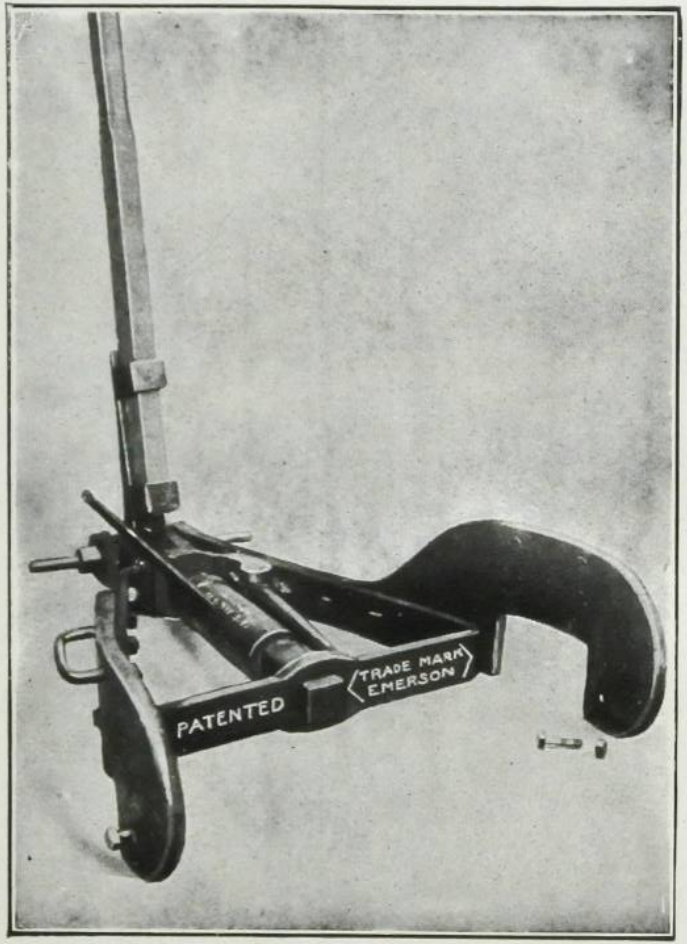
	Shipping Weight	List Price	Code Word
No. 1, for rails 20 to 40 lbs. inclusive	300 lbs.	$105 00	*Rolon*
No. 2, for rails 41 to 60 lbs. inclusive	360 lbs.	115 00	*Rolto*
No. 3, for rails 61 to 70 lbs. inclusive	400 lbs.	140 00	*Rolee*
No. 4, for rails 71 to 80 lbs. inclusive	470 lbs.	180 00	*Rolor*
No. 5, for rails 81 to 90 lbs. inclusive	520 lbs.	230 00	*Roliv*
No. 6, for rails 91 to 100 lbs. inclusive	830 lbs.	400 00	*Rolix*

"Jim Crow" Rail Bender



Best wrought steel and iron, with machine-cut, square-thread steel screw. Most compact and simplest device for bending and straightening light rails, pipe, car irons, etc.

Size No.	00	0	1	2	3	3½	4	
For steel rails, up to	16	20	25	50	68	78	95	Lbs. per yd.
Price, each	$15 00	$18 00	$22 00	$30 00	$36 00	$45 00	$54 00	With lever
Weight with lever	33	45	67	98	145	160	200	Lbs.
Span to c'nt'r of claws	12	16	19	22	27	28	28	Inches
Diameter of screw	1½	1¾	2	2¼	2½	2⅝	2¾	Inches
Code word	Jimmy	Jimmo	Jimon	Jimto	Jimee	Jimaf	James	



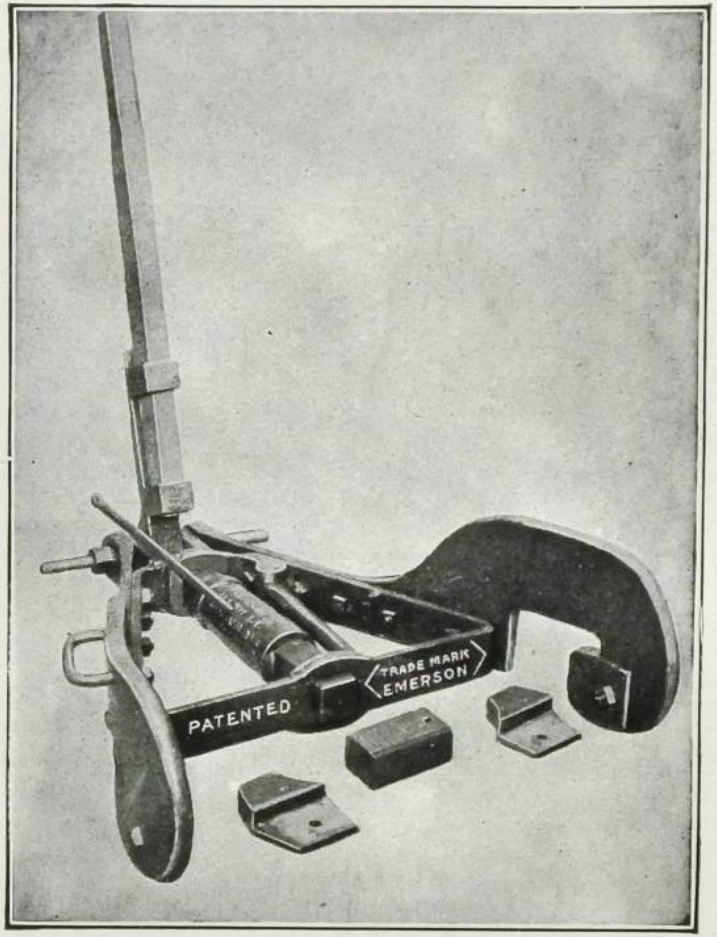
Universal Rail-Bender and Straightener

Emerson Pattern

There are four sizes—which bend rails up to 115 lbs. to the yard.

When ordering specify Emerson Street Rail-Bending and Straightening Machine, sending blue print or tracing of rails with order.

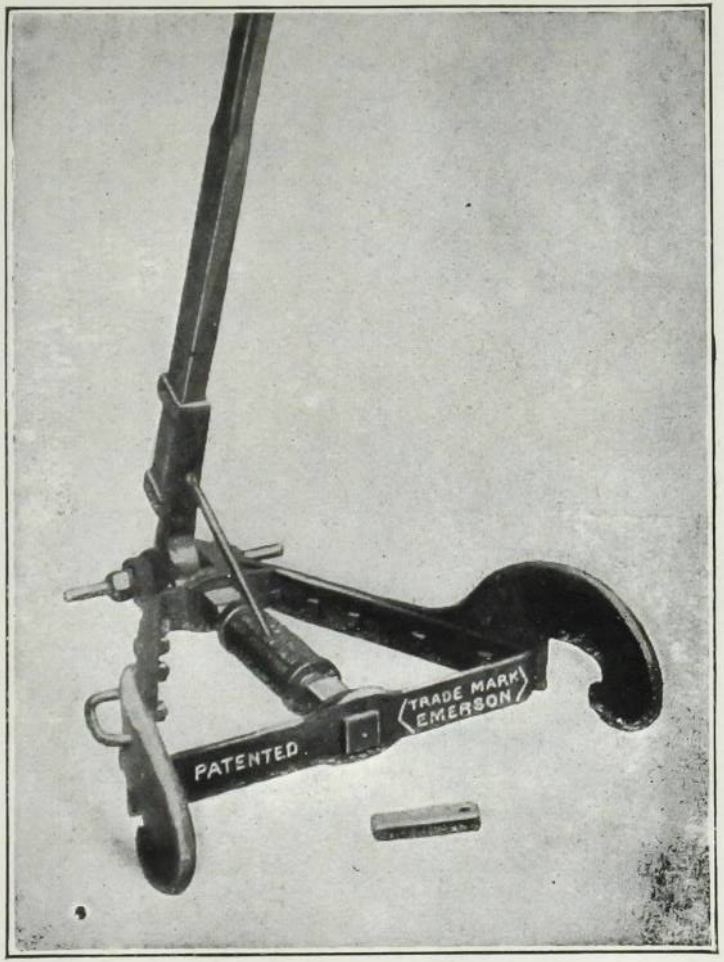
Will furnish reverse or regular leverage, as desired.



Machine showing jaws before dies are applied.

Machine showing dies in jaws and additional dies ready to use.

This machine, ***if supplied with necessary dies,*** **will curve or straighten** *any and all shaped rails.*



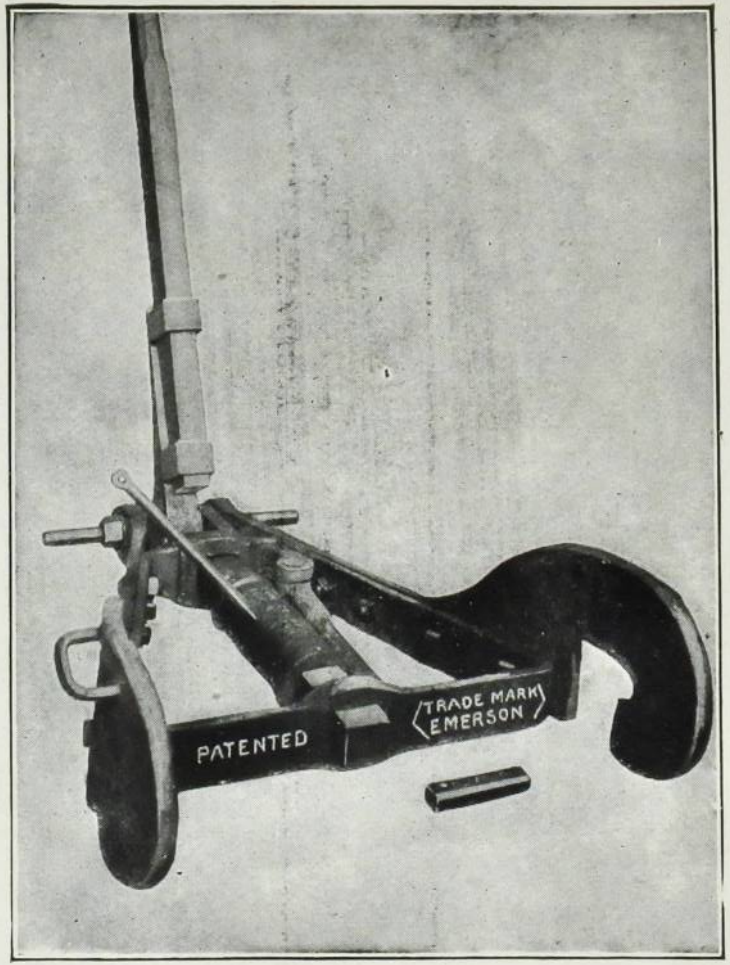
Size No. 3

Universal Rail-Bender and Straightener

Emerson Pattern

Immediate Shipments Interchangeable parts always in stock.

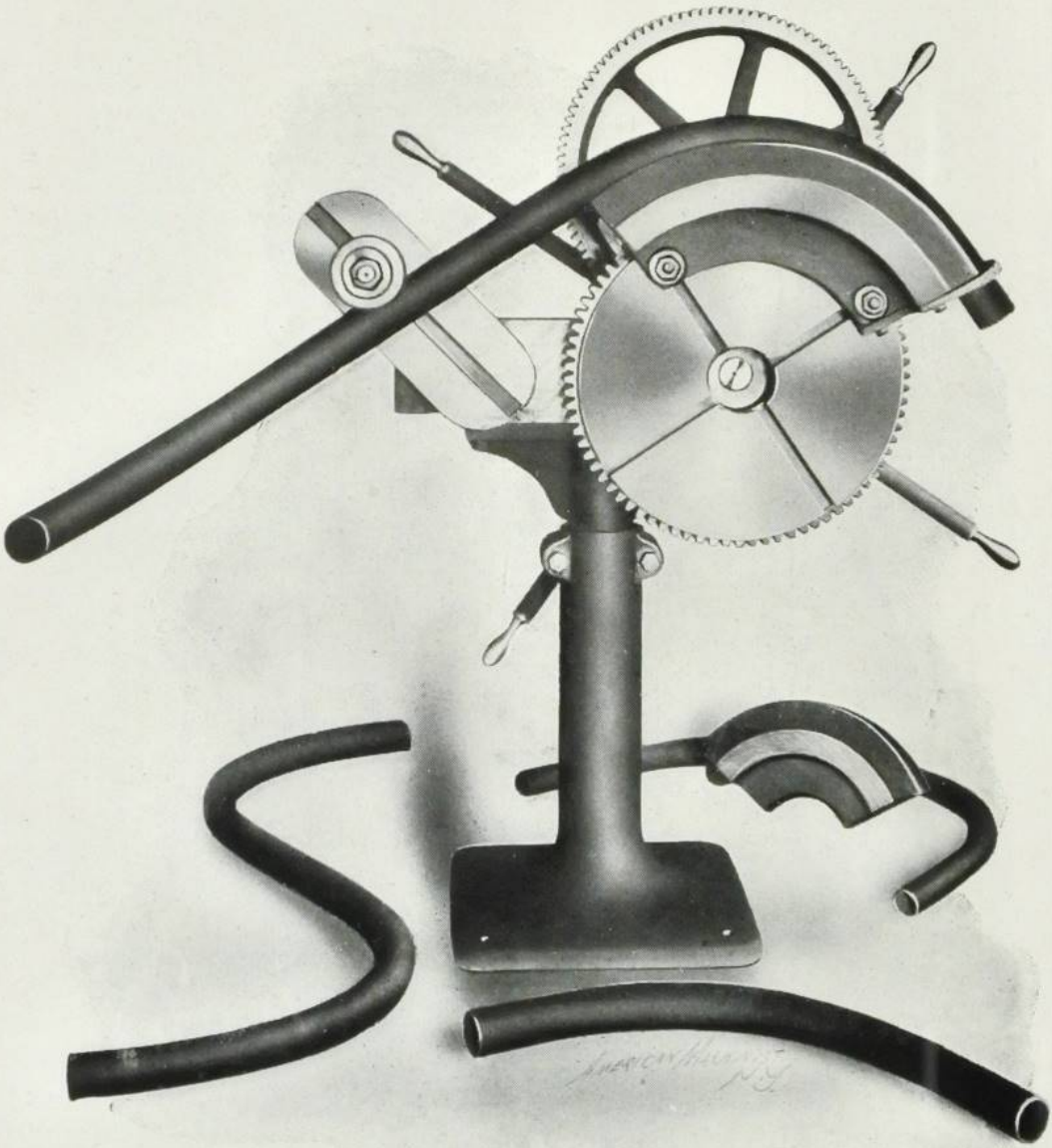
There are four sizes—Size No. 1, for tee rails up to 45 lbs. to the yd. Size No. 2, for tee rails 45 to 65 lbs. to the yd. Size No. 3, for tee rails 65 to 90 lbs. to the yd. Size No. 4, for tee rails 90 to 115 lbs. to the yd.



Size No. 4

Pipe Bending Machine

Code Word—"BENDING"



OUR Pipe Bending Machine has many new and desirable features. It is strongly constructed and will stand great stress. The gears are all cut and of heavy pitch; the ratio of gearing, 25 to 1, gives a powerful leverage. In fact, a boy can bend 2" pipe with little effort. The continuous rotary movement of the face plate, upon which the quadrants or

Pipe Bending Machine—Continued

formers are located, is a desirable advantage. This is obviously of much importance and convenience for many classes of work.

The resistance stud is located on a movable arm provided with a "T" slot, permitting the stud to be placed anywhere within the radius of the arm. This particular feature offers adaptability for any sort of pipe bending.

The face plate is provided with four "T" slots upon which any style or shape former or quadrant can be attached, again showing the versatility of our machine.

It will bend an infinite variety of shapes without leaving any mark or disfigurement on the work operated upon.

The machine is designed to be easily portable, and has a telescopic stand, which can be raised or lowered to a suitable height. When base is fastened, upper part swivels.

Plain or adjustable stands furnished as per requirement.

Piping of steel, iron, brass, copper and other material can be bent cold up to and including 2" in diameter. The machine is also adaptable by means of special formers for bending light angles, flats and tee bars.

When pipes are coated by the Sabin Process, galvanized, tinned, etc., this machine will bend such pipe to any desired shape without breaking the coating in any way.

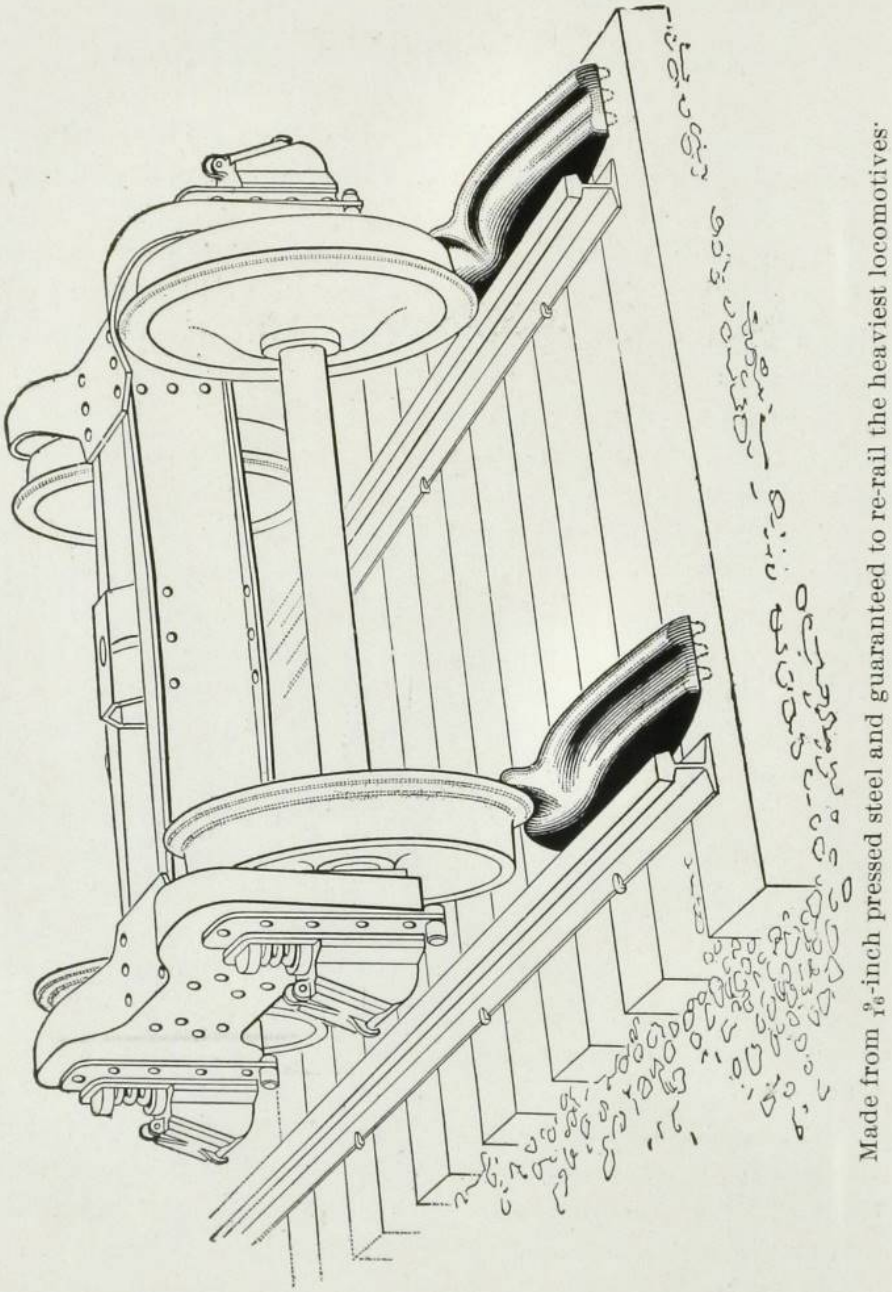
The quadrants furnished with the machine are for 1" pipe, with a radius of 6"; 1¼" pipe, with a radius of 9"; 1½" pipe, with a radius of 12", and 2" pipe, with a radius of 14". While these four sizes are furnished with the machine, the fact that the smaller sizes of pipe can be bent in the larger quadrants makes changing the quadrants unnecessary, unless a shorter radius than the larger quadrant will give is desired.

The gears, body of machine and stand have been carefully proportioned for the stress that they must stand.

The weight of the machine complete is 750 pounds, and is a very desirable machine in any plant where there is much pipe or conduit work.

The base of the stand is 18" x 18", the outside dimensions of the machine are width 4'7", height 5'.

Locomotive and Car Replacers



Made from $\frac{9}{16}$-inch pressed steel and guaranteed to re-rail the heaviest locomotives

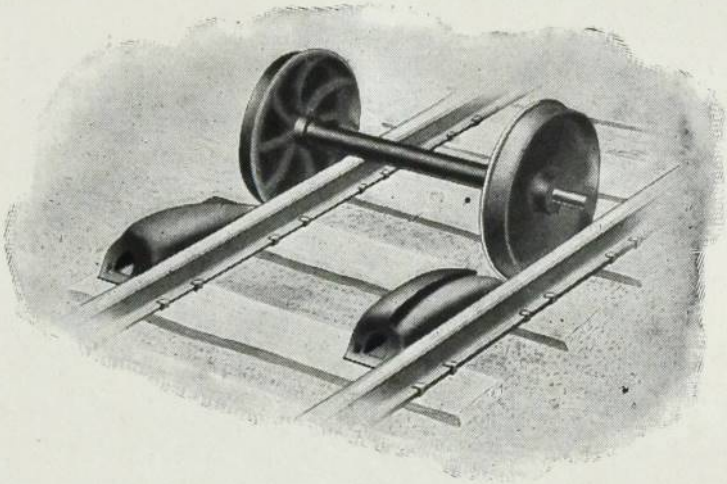
Easily handled by one man.

Directions:—Locate high frog outside of rail to lift wheel flange over the rail. Place the other frog opposite, inside the rail.

No. 1 replacer, 160 lbs. per pair, for 6-in. rail.
No. 2 replacer, 150 lbs. per pair, for rail from $4\frac{1}{2}$ to 5 in. high.
No. 3 replacer, 50 lbs. per pair, for any rail under $4\frac{1}{2}$ in. high.

Write us for prices and compare with other.

Aldon Frogs



Are made right and left, for use on either side of the rail, and in either direction.

They are made in four sizes, as follows:

No. 1—Cast steel; weight, 200 lbs. per pair; suitable for heaviest equipment and for rails of 100 lbs. or less.

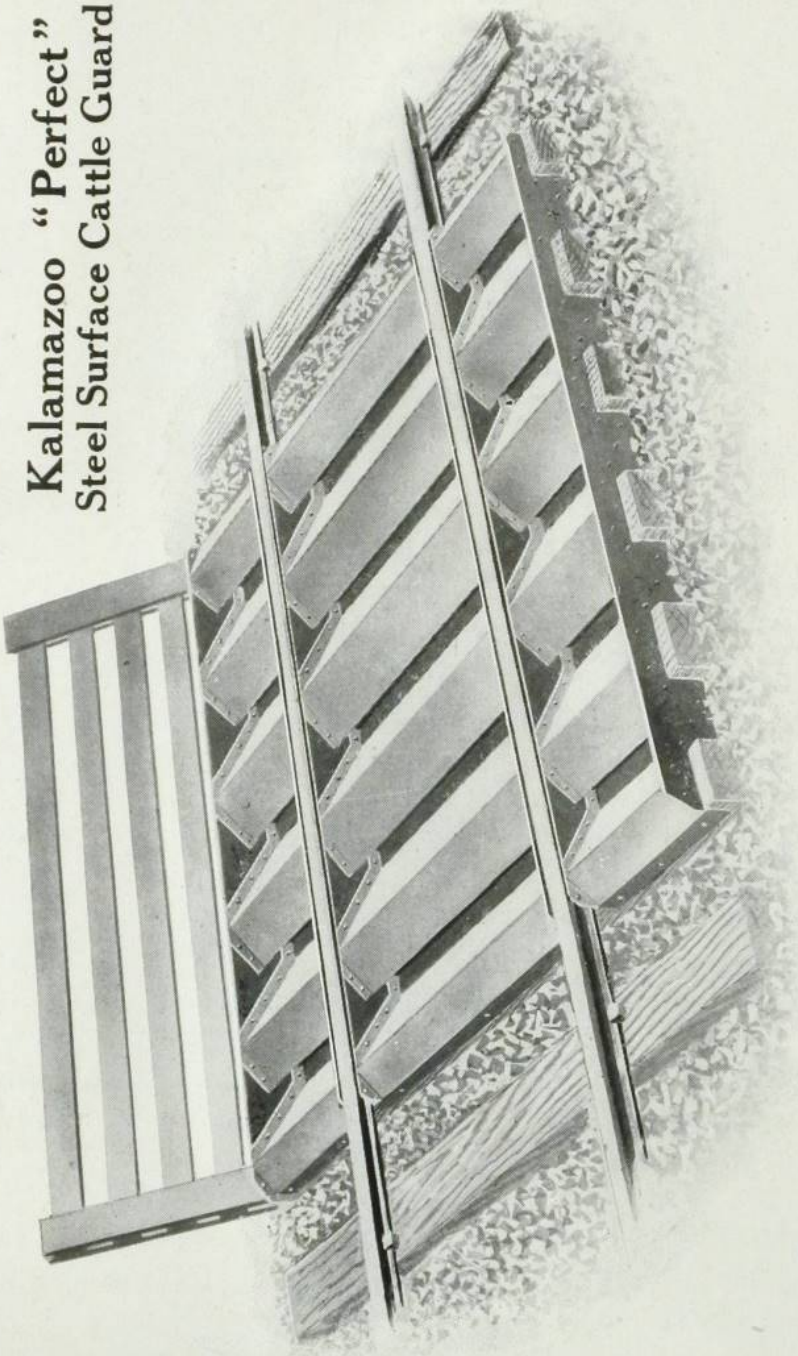
No. 2—Cast steel; weight, 180 lbs. per pair; suitable for all modern equipment, and for rails 85 lbs. or less.

No. 3—Malleable iron; weight, 100 lbs. per pair; suitable for electric suburban service, light engines and cars, and for rails of 65 lbs. or less.

No. 4—Malleable iron; weight, 50 lbs. per pair; suitable for industrial and mine railways, for equipment not exceeding 15 tons, and for rails 35 lbs. or less.

Write us for prices, and compare them with others.

Kalamazoo "Perfect" Steel Surface Cattle Guard



Code Word—"PERFECT"

An effective stock turner for any section of country

This is the ONE Guard that never disappoints, and is all that the name implies.

Kalamazoo "Perfect" Steel Surface Cattle Guard

Code Word—"PERFECT"

An effective stock turner for any section of country

THERE are Cattle Guards galore, many altogether worthless, others to a degree efficient; none save the "Perfect" proof against the knowing animal. The trouble has been at the very start—the design. Everybody has labored under the old idea that to deter would-be trespassing animals they must be either wickedly punished or shown a bristling front of jagged points. Our idea is a departure—to render crossing physically impossible. Notice with what result:

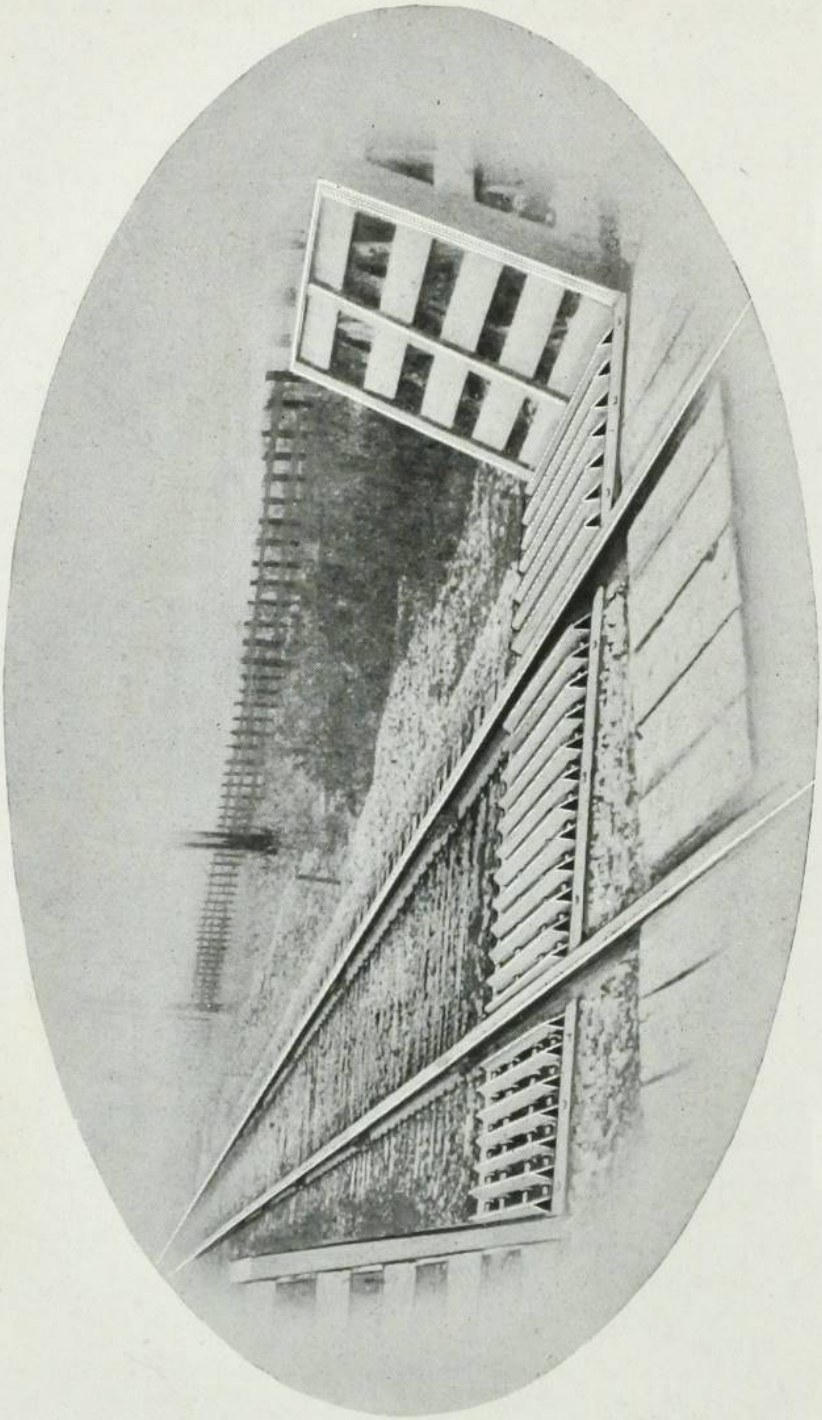
Animals at initial step slide toe first against slot at base and cannot advance, but are free to withdraw without slightest injury. Repeated efforts discourage, and animals are never goaded to frenzy as with sharp pointed guards. The "Perfect" turns the most recalcitrant steers and bronchos at troublesome crossings. At just such, trial is courted. Length, 9 ft. Weight, 475 lbs.

Other Advantages Apparent by a Glance at Cut are:

1. Made in three sections only, ready-to-place, saves expense of 10 x 10 inch x 10 feet hardwood ties and much excavating.
2. Offers no catching points for dragging chains.
3. Is readily removable during track overhauling.
4. Chokes weed growth.
5. Has a solid anchorage in track; cannot rattle to pieces.
6. Saves one to two dollars "assembling" as against guards of many parts.
7. After assembled, guards are dipped in an asphaltum bath to fill all crevices and cover all surfaces with a thick, tenacious coat.
8. Is proof against corrosion.
9. Is self-cleansing of snow and rubbish by draught.
10. Stays personal injury suits from accidental falling from which railroads are not absolved when using dangerous guards.
11. Is heavier; does not emit jingling sounds from passing trains.

This is the ONE Guard that never disappoints, and is all that the name implies.

No. 15 Wood Surface Cattle Guard



Cipher—"OAKEN"

We make other designs of Wood Cattle Guards. Also are prepared to make Wood Guards according to specifications furnished by customers.

No. 15 Wood Surface Cattle Guard

Code Word—"OAKEN"

THIS wood cattle guard is made of strictly northern grown white oak, a dense tough wood, well seasoned, and will outlast any material that can be used for cattle guard purposes.

It is not subject to corrosion as metal guards, nor disintegration as tile guards; being well up off the earth the Oak will last indefinitely.

The sections are assembled rigidly together, by means of steel rods and cast iron spacing spools. Being solidly bound together, there is no chance of the guard becoming racked out of shape by the vibration of the track.

The expense of installing is but a fraction of the cost of laying down any guard made of many pieces. When tracks need overhauling the withdrawal of the retaining spikes at each end permit of lifting bodily out of the way; not so with many-piece guards.

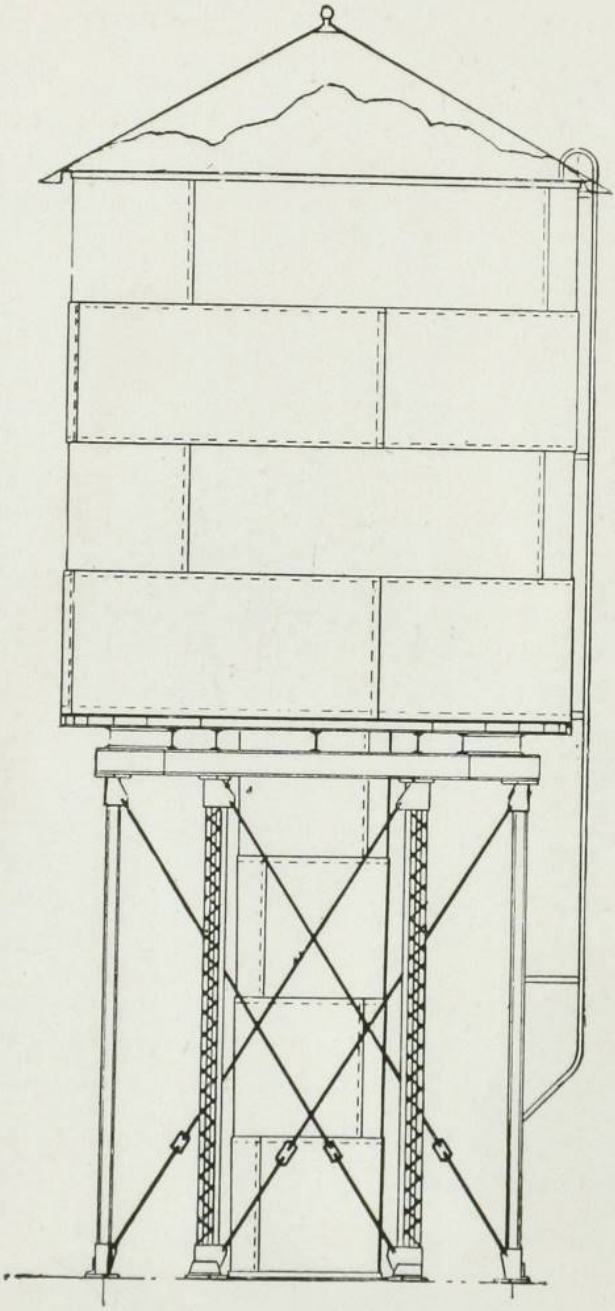
The frost will come quickly from under the wood guard, which is not the case with any guard covering the ground closely, and therefore acting as a cover from below which frost comes last and leaves an irregular track.

Illustration shows one of our standard designs, and is similar to that used by the Michigan Central Ry., the Lake Shore & Michigan Southern Ry., and many other prominent roads.

Eight feet is the length commonly used; however, guards can be made any length desired.

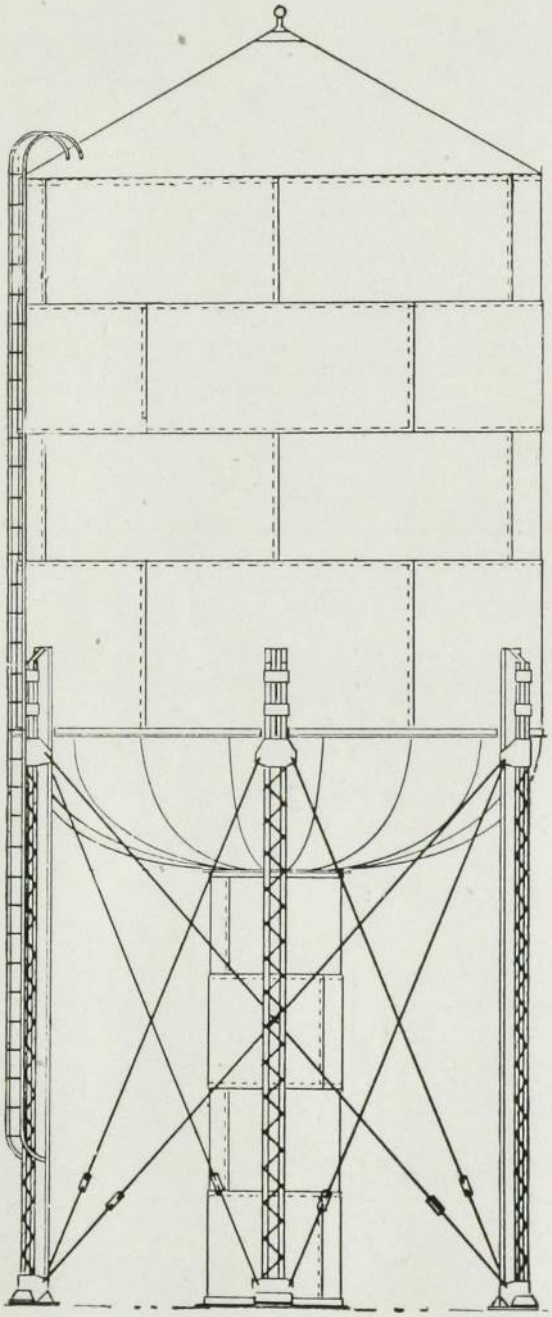
We make other designs of Wood Cattle Guards. Also are prepared to make Wood Guards according to specifications furnished by customers.

Steel Water Tank with Steel Tower



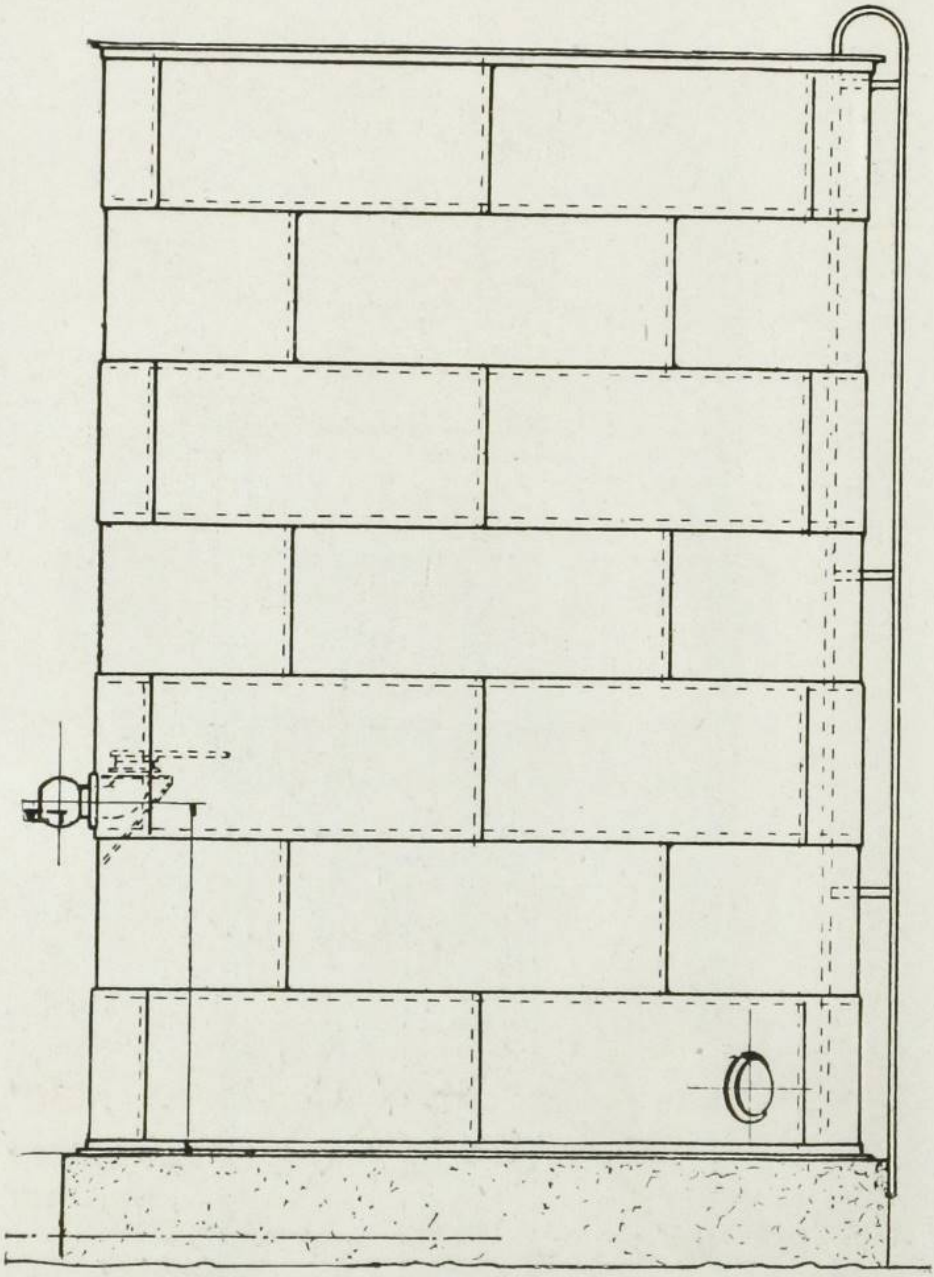
The above cut shows construction, with supported bottom and central water leg in place of frost box. Furnished promptly; of all capacities and heights of tower, with or without metal roof. Write us about them.

Steel Water Tank with Steel Tower



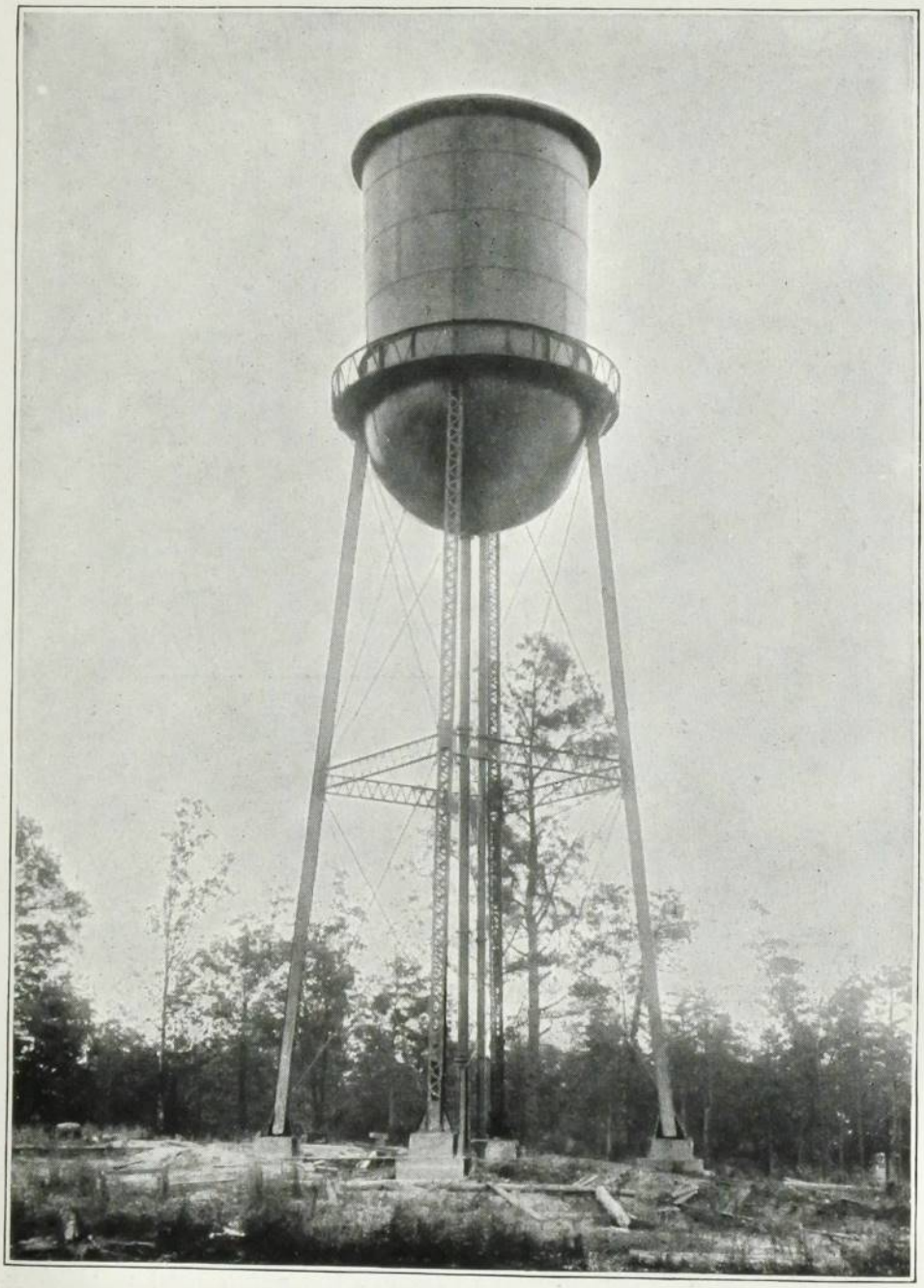
The above tank can be made of any capacity, on four or six-post tower, to meet any requirements. This form of bottom with the central water leg permits the sediment to be blown out without entirely emptying the tank. Let us know your requirements.

Steel Water Tank with Steel Tower



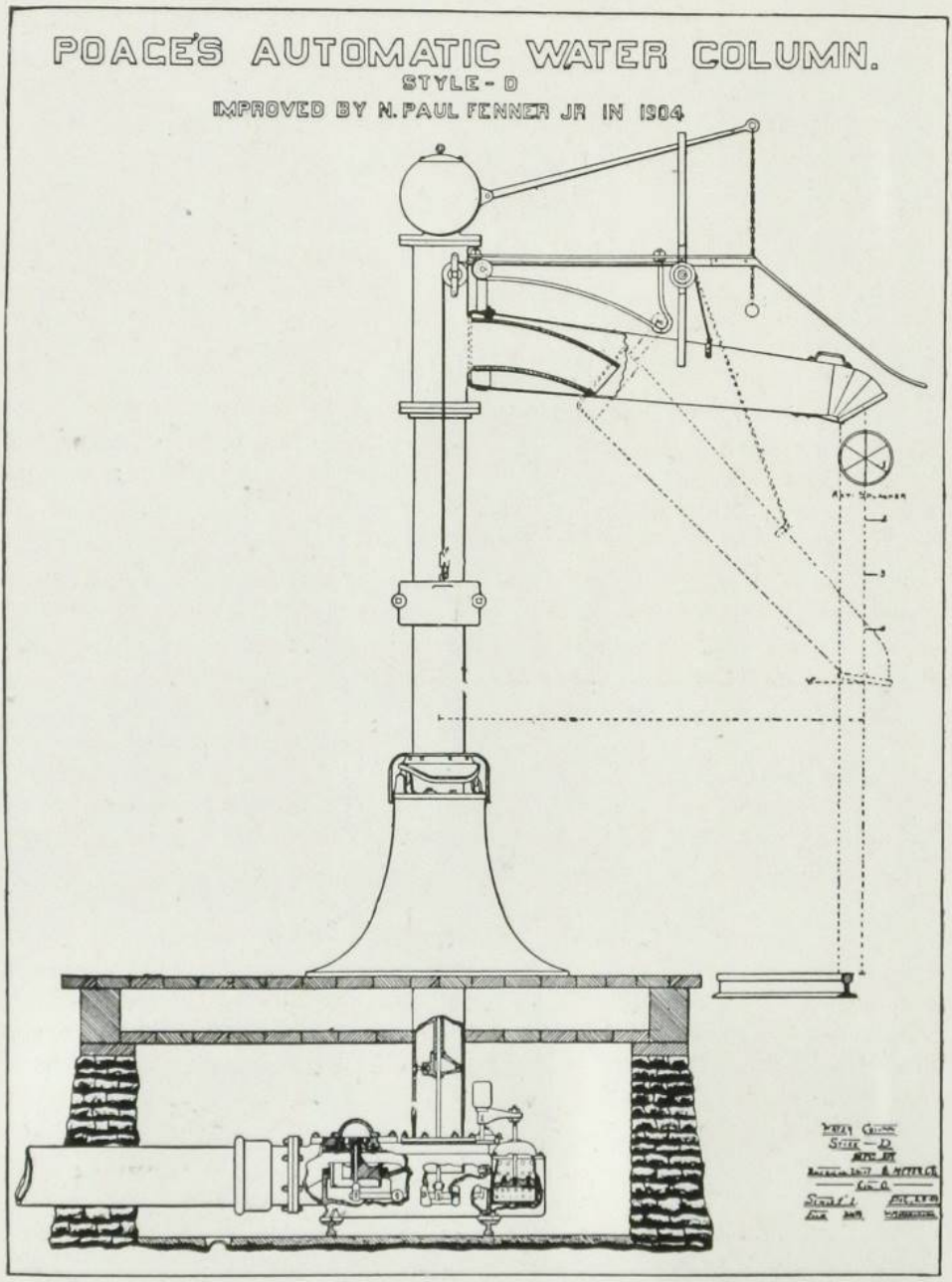
This type of tank is preferred by many railroads, as it is an economical orm, where the required head is low or the storage capacity desired is very large. Can be promptly furnished, of any diameter and height, with metal roof if desired. Give us your inquiries.

Steel Water Tank with Steel Tower



This type of tank is very popular with the railroads, as it is pleasing in appearance and very economical where storage at a considerable elevation is required. Can furnish this style of any capacity and height of tower desired. Let us quote you prices.

Poage's Automatic Water Column



Poage Water Columns are made with rigid and with flexible spouts. Style "D" is provided with flexible spout. The range of adjustment is five feet with discharge nozzle following a perpendicular line. It has a lateral movement of three feet. The joint is open telescopic. It is positively non-freezable.

Poage's Automatic Water Column—Continued

Poage Style "B" Column is provided with rigid spout.

Poage Columns are made in 6", 8", 10" and 12" sizes.

The Poage Columns are standard on many of the railroads in this and in the foreign countries. When ordering Water Columns, please state size, height over rail, and distance center of column to center of track. State style of column wanted. State maximum pressure where it is known.

Description

The Poage Water Columns are made of the best material throughout, the various parts being made of iron, steel and gun metal. Every part, from the smallest to the largest, is given close inspection as to quality of material and workmanship before entering the Assembling Department. For these reasons the repairs required are reduced to a minimum, and the mechanism requires but little attention. Every part is interchangeable and can be replaced from our factory at any time on short notice.

No Retardation

The flow of water through the column from the mains is direct, and there is no hindrance whatever to the full stream of water passing through the column. Capacity of chambers is increased to avoid retardation of flow.

Simplicity

The taking of water is very simple, all being done by one man without leaving the tender. The fireman draws the spout around to position for taking water, pulls down the lever (No. 110), and the flow is immediate.

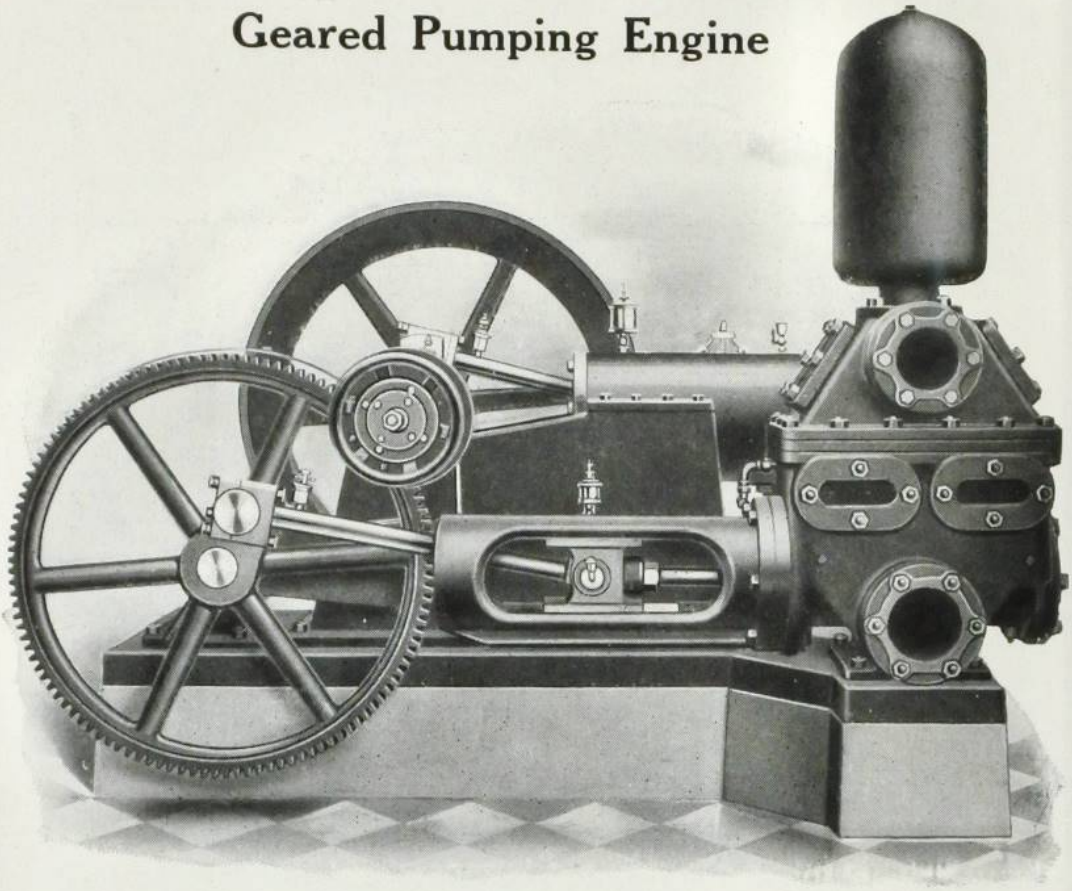
Automatic

The lever can be fastened down under the pin in the guide for that purpose, and when sufficient water has been taken, the lever is easily released from under this pin. The mechanism will do the rest. No part of the action of our columns is controlled by *springs, as they are not reliable.* It is operated entirely by gravity.

Safety

The spout, being released, will return to its position (by gravity) away from and parallel to the track, and remain in that position. Its action is positive; never forgets; no locking required. It can not swing over the track alone, nor can the lever be operated while the spout is parallel to track. The advantages of these features are obvious. The wind can not blow the spout across the track to cause accident, nor can mischievous boys turn on the water.

Geared Pumping Engine



THIS cut represents our geared pumping engine, designed to operate on either gas or gasoline. This machine is entirely self-contained. The engine used is the standard engine mounted on cast iron sub-base, which also supports the pump. The machine can be placed almost anywhere without special foundation. The pump used is the standard pattern, the main frame being of the girder pattern, the crosshead guides and main bearings being cast in one piece, insuring perfect alignment.

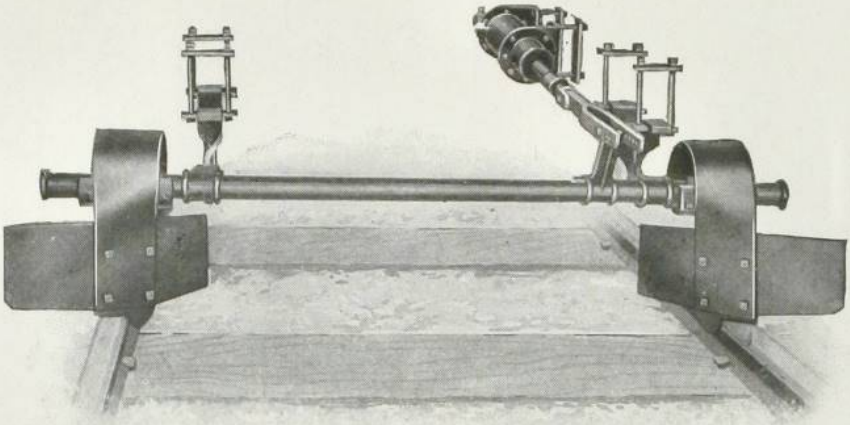
The crosshead guides are bored and crosshead fitted with adjustable slippers. The gears are of cast iron, accurately cut by machine. The pinion is held in place on crank shaft by friction clutch, which can be thrown in or out while the engine is in motion.

The water end is of the submerged piston type, the cylinder being fitted with removable brass liner; valve seats are of bronze, screwed into decks; valves are of rubber; guards and springs of bronze. Discharge and suction pipe connections are made with companion flanges. The water end is bolted to crosshead guides and can easily be removed or replaced should extensive repairs be necessary.

List of Sizes

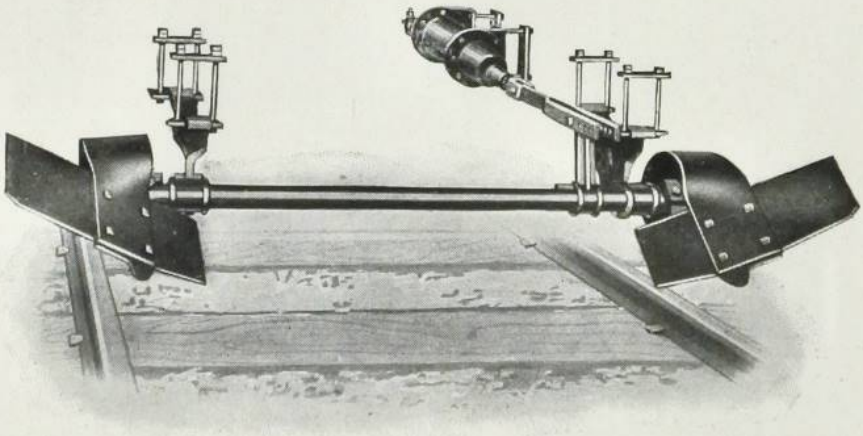
Horse Power	Diameter Cylinder	Stroke	Gallons per Stroke	Strokes per Minute	Gallons per Minute	Head in Feet	Suction	Disch'rge	Floor Space *Approximate*	Shipping Weight	Code Word
4	4	7	.38	90	34	250	3	2½	36-84	3500	*Drabble*
4	5	7	.59	90	53	150	3	3	36-84	3550	*Dragon*
4	6	7	.85	90	76	100	3½	3	40-84	3600	*Dramatic*
4	7	7	1.17	90	105	50	4	4	40-84	3700	*Drastic*
6	5	7	.59	90	53	250	3	3	36-84	4000	*Draul*
6	6	7	.85	90	76	150	3½	3	40-84	4150	*Dread*
6	7	7	1.17	90	105	100	4	4	40-84	4200	*Drench*
6	8	7	1.52	90	136	50	4	4	42-84	4300	*Dresser*
8	6	8	.98	80	75	250	4	4	40-89	4800	*Drinking*
8	7	8	1.33	80	106	150	4	4	40-89	4900	*Drivel*
8	8	8	1.74	80	139	100	5	4	44-89	4950	*Drone*
8	10	8	2 72	80	217	50	6	5	44-89	5000	*Drover*
10	6	12	1.23	80	98	250	4	3	42-92	5500	*Droudily*
10	7	12	1.99	80	160	150	5	4	44-92	5700	*Drubbing*
10	8	12	2 61	80	208	100	5	5	48-92	5800	*Drudge*
10	10	12	4.08	80	326	50	6	6	48-92	5950	*Druggist*
15	7	12	1.99	80	160	250	5	4	48-106	7500	*Druid*
15	8	12	2.61	80	208	150	5	5	48-106	7550	*Drull*
15	10	12	4.08	80	326	100	6	6	54-106	7600	*Drum*
15	12	12	5 87	80	469	50	7	7	54-106	7700	*Dry*

Root Locomotive Spring Snow Scraper



Rear View.

The above cut shows Scraper held in position by air pressure, which pressure can be regulated according to conditions of snow.



Rear View.

The above cut shows Root Scraper after air has been released, the blades being drawn up by spring in air cylinder, and held in position about eight inches above rail.

The Root Locomotive Spring Scraper

DESCRIPTION

IS the only device of the kind yet invented that is absolutely **Safe** on the rail for any condition of track and at any rate of speed. It does not require raising for switches, crossings, or the like, in fact, needs no attention whatever when going ahead. The Root Scraper is operated by air from the cab and will handle any condition of snow, whether dry, wet or packed. This scraper cleans the rail for the engine and train, and removes the snow 8 in. each side of the rail even with the top; also cleans the rail flange 1½ in. x 1½ in. below top of rail, preventing the wheel flanges from compressing the snow into ice.

This scraper is designed for cleaning the rail and flange of all snow left by the pilot on locomotives and has absolutely made good on all snow plows for cleaning the rail of all snow left by the plow.

While this is a new device for Locomotives (as well as our method of operating by air pressure) the Root Scraper, as applied to Street and Interurban Electric Cars, has been on the market for four years. It has been fully tried out and has "made good" in all cases. It is now perfected and we absolutely guarantee it **Safe, Economical,** and to meet all claims made for it.

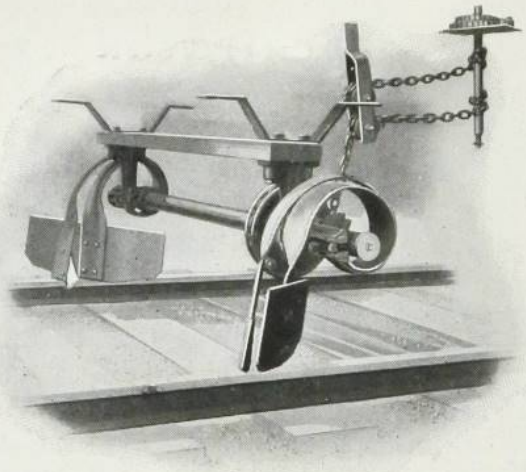
The price per Scraper, including air cylinder, and air valve, is $50.00 per engine, and a trial order will enable you to demonstrate that the device will fully pay for itself every day there is snow on the rail. Its cost is so low in comparison with similar devices that all engines should be equipped with them.

All Root Scrapers furnished by this company are shipped on approval, fully warranted to meet all claims made for them, otherwise to be held subject to our orde and we solicit your orders with this understanding.

With no other scraping device can you maintain clean rails for the locomotive as cheaply; furthermore, the original cost is small in comparison, as well as the expense of maintaining.

Try to imagine a train of cars in a winter's storm with the rails kept clean from snow by a device that requires no attention from the engineer. If this can be done, figure the saving of expense; also imagine the satisfaction of making schedule time throughout the winter season.

The Root Railway Spring Scraper



Special features of advantage claimed for The Root Railway Spring Scraper:

It is the only practical Scraper made to-day, for in winter snows you can maintain 90 per cent of your summer schedule.

We guarantee **3 to 1** better results than can be attained with any other Scraper now on the market.

It meets any and all conditions on city or interurban lines, and gives the same results on any type of rail. It easily installs on any type of car, either single or double truck.

Our Spring Scraper requires less power, deposits the snow farther from the track, and leaves the rail and groove clean so that contact from wheel to rail is absolutely perfect.

When in working position, it needs no attention, and does not have to be raised for switches, crossings or high blocks in pavement.

It cleans rail and groove even when track is 2 inches below pavement.

It gives the same results whatever the conditions of snow **—wet, dry or packed.**

Any Scrapers we may furnish are sent guaranteed to merit approval, and may be returned if they do not demonstrate all claims made for them.

Let us send you catalogue and tell you more about them.

Kalamazoo Railway Supply Co., *Manufacturers*

KALAMAZOO, MICHIGAN

Including the articles shown in this catalogue

We offer the following specialties for railroad construction and maintenance, for which inquiries are respectfully solicited:

Section Hand Cars
Section Push Cars
Track-laying Cars
Inspection Cars
Tower Hand Cars
Dump Cars
Velocipede Cars
Gasoline Motor Inspection Cars
Gasoline Motor Section Cars
Cattle Guards, Steel and Wood
Tanks
Towers
Tank Discharge Fixtures
Water Columns
Gasoline Pumping Machinery
Steam Pumping Machinery
Water Stations Erected
Ratchet, Track and Car Jacks
Friction Track Jacks
Screw Jacks
Hydraulic Jacks
Moore Track Drills
Moore Bonding Drills
Rail Benders
Track Levels
Track Gauges
Curve Lining Gauges
Track Tools
Car Replacers
Wheel and Drag Scrapers
Grading Plows
Wheelbarrows
Warehouse Trucks
Baggage Barrows
Express Wagons
Railroad Cranes
Street Railway Track Scrapers
Locomotive Flangers
Street Car Fenders
Trolley Wheels and Harps

KALAMAZOO RAILWAY SUPPLY COMPANY

MANUFACTURERS

Cable Address
"VELOCIPEDE"

Kalamazoo, Michigan, U. S. A.

USEFUL INFORMATION

Table of Weights and Measures

Long Measure

12 inches ..... 1 foot
3 feet ..... 1 yard
2 yards ..... 1 fathom
16½ feet ..... 1 rod
4 rods ..... 1 chain
10 chains ..... 1 furlong
8 furlongs ..... 1 mile
3 miles ..... 1 league

Square Measure

9 square feet ..... 1 square yard
30¼ square yards ..... 1 square rod
40 square rods ..... 1 square rood
8 square roods ..... 1 square acre
640 square acres ..... 1 square mile
An acre is 209 square feet.

Dry Measure

2 pints ..... 1 quart
4 quarts ..... 1 peck
4 pecks ..... 1 bushel

Liquid Measure

4 gills ..... 1 pint
2 pints ..... 1 quart
4 quarts ..... 1 gallon

Avoirdupois Weight

16 drams ..... 1 ounce
16 ounces ..... 1 pound
25 pounds ..... 1 quarter
4 quarters ..... 1 hundred
20 hundreds ..... 1 ton

Apothecaries Weight

20 grains ..... 1 scruple
3 scruples ..... 1 dram
8 drams ..... 1 ounce
12 ounces ..... 1 pound

Time Measure

60 seconds ..... 1 minute
60 minutes ..... 1 hour
24 hours ..... 1 day
7 days ..... 1 week
52 weeks
12 calendar months ..... 1 year
365 days

Troy Weight

24 grains ..... 1 pennyweight
20 pennyweights ..... 1 ounce
13 ounces ..... 1 pound

Cubic Measure

1728 cubic inches ..... 1 cubic foot
27 cubic feet ..... 1 cubic yard
16 cubic feet ..... 1 cord foot
8 cord feet
128 cubic feet ..... 1 cord

Land Measure

7.92 inches ..... 1 link
25 links ..... 1 rod
4 rods ..... 1 chain
80 chains ..... 1 mile

Circular Measure

60 seconds ..... 1 minute
60 minutes ..... 1 degree
30 degrees ..... 1 sign
60 degrees ..... 1 sextant
90 degrees ..... 1 quadrant
360 degrees ..... 1 circle

Table of Quantities

12 units ..... 1 dozen
12 dozen ..... 1 gross
20 units ..... 1 score
24 sheets ..... 1 quire
20 quires ..... 1 ream

General Measure

A mile ..... 5280 feet
A cubit ..... 2 feet
A pace ..... 3 feet
A palm ..... 3 inches
A hand ..... 4 inches
A span ..... 10⅞ inches

Wells and cisterns hold for each foot in depth:

Diam.	Gallons
2 feet	23
3 feet	53
4 feet	94
5 feet	194
6 feet	211
7 feet	288
8 feet	375

A Box Contains

4x4x4 ½ inches ..... 1 quart
8x8x8 ½ inches ..... 1 peck
26x15 ½x8 inches ..... 1 bushel
24x16x28 inches ..... 1 barrel

Metric Measures

Length—10 Millimeters=1 centimeter=.39 inches.

10 centimeters=1 decimeter=3.94 inches.

10 decimeters=1 meter=39.37 inches, or 3.28 feet, or 1.09 yards.

10 M=1 dekameter.

10 dekameters=1 hektameter.

10 hektameters=1 kilo.

1000 meters=1 kilometer=1093.61 yards or .62 mile.

Surface—100 square millimeters=1 square centimeter=1.55 square inches.

100 square centimeters=1 square decimeter=1.55 square inches.

100 square decimeters=1 square meter=1550. square inches=10.764 square feet=1.196 square yards.

100 square meters=1 square kilometer=.38 square mile=247.11 acres.

Volume—1000 cubic millimeters=1 cu. cent.=.06102 cu. in.

1000 cubic centimeters=1 cu. decimeter=61.02 cu. in.=1 liter.

1000 cubic decimeters=1 cu. meter=35.3166 cu. feet=1.3080 cu. yards=1 liter=1.7608 pints.

Mass—10 millimeters=1 centigram.

10 centigrams=1 decigram.

10 decigrams=1 grain=.03527 ounces.

1000 grains=1 kilogram=2.2046 pounds.

Interchangeable Tables between United States and Metric Systems

Base—1 Meter=39.3704 Inches.

No.	64th inch to Millimeters	Millimeters to 64ths inch	Inches to Centimeters	Centimeters to inches	Metres to feet	Feet to meters	Kilometers to miles	Miles to Kilometers
1	0.3969	2.5197	2.5400	0.3937	3.2809	0.3048	0.6214	1.6093
2	0.7938	5.0393	5.0799	0.7874	6.5617	0.6096	1.2428	3.2187
3	1.1906	7.5590	7.6199	1.1811	9.8426	0.9144	1.8641	4.8280
4	1.5875	10.0787	10.1599	1.5748	13.1235	1.2192	2.4855	6.4373
5	1.9844	12.5984	12.6999	1.9685	16.4043	1.5240	3.1068	8.0467
6	2.3813	15.1180	15.2398	2.3622	19.6852	1.8287	3.7283	9.6560
7	2.7781	17.6377	17.7798	2.7559	22.9661	2.1335	4.3496	11.2653
8	3.1750	20.1574	20.3198	3.1496	26.2470	2.4383	4.9710	12.8746
9	3.5719	22.6770	22.8597	3.5433	29.5278	2.7431	5.5923	14.4840

British Weights and Measures
Compared with the Simple Metric System

Avoirdupois Weight

Drachm	=27⅓ grains (27.34375)
Ounce	=16 drs., 437.5 grains.
Pound	=16 oz. 256 dr. 7000 gr.
Customary Stone	=Butcher's Meat=8 lb.
Legal Stone	=Horseman's Weight, 14 lb.
Quarter	=28 lb.
Cental or Quintal	=100 lb.
Hundredweight	=4 qrs., 112 lb.
Ton	=20 cwt., 2,240 lb.

Troy Weight

Carat	=3.17 grains.
Pennyweight	=24 grains.
Ounce	=20 dwt., 480 grains
Pound	=12 oz., 240 dwt., 5,760 grains.
Hundredweight	=100 lb.

Apothecaries' Weight

Scruple	=20 grains	= 20 grains
Drachm	= 3 scruples	= 60 "
Ounce	= 8 drachms	= 480 "
Pound	=12 ounces	=5,760 "

The avoirdupois oz. of 437½ grains, and the lb. of 7,000 grains, are the weights named in the British Pharmacopœia; drugs are purchased by avoirdupois, but compounded by apothecaries' weight. The apothecaries' oz. and lb. may now be considered obsolete.

Hay and Straw

Truss of Straw, 36 lb. Truss of Old Hay, 56 lb. Truss of New Hay (to September 1st), 60 lb. Load, 36 Trusses—Straw, 11 cwt. 2 qr. 8 lb. Old Hay, 18 cwt.; New Hay, 19 cwt. 1 qr. 4 lb.

Cubic or Solid Measure

Cubic Foot	=1,728 cubic inches.
Cubic Yard	=27 cubic feet, 21.033 bu.
Stack of Wood	=108 cubic feet.
Shipping Ton	=40 cu. ft. merchandise.
Shipping Ton	=42 cu. ft. timber.
Ton of Displacement of a Ship	=35 cubic feet.

British Weights and Measures—Continued

Apothecaries' Fluid Measure

60 Minims (drops) =1 fluid drachm.
8 Drachms =1 ounce.
20 Ounces =1 pint.
8 Pints =1 gallon.
1 Drachm =1 teaspoonful.
2 Drachms =1 dessertspoonful.
4 Drachms =1 tablespoonful.
2 Ounces =1 wineglassful.
3 Ounces =1 teacupful.

Prescribing medicine by the spoon, glass, or cupful is unsafe, as all those vessels vary in size. Graduated glass measures may be purchased for a few pence.

Dry or Corn Measure

Quart =2 pints.
Pottle =2 quarts.
Gallon =4 quarts.
Peck =2 gallons.
Bushel =4 pecks.

Strike = 2 bushels.
Coomb = 4 bushels.
Quarter = 8 bushels.
Load = 5 quarters.
Last =10 quarters.

Boll of Meal = 140 lbs.; 2 Bolls = 1 Sack.

Wheat and other cereals are commonly sold by weight, the bushel being thus reckoned: Wheat, English, 63 lb. Foreign, 62 lb. Barley, English, 52 and 56 lb. French, 52½ lb. Mediterranean, 50 lb. Oats, English, 40 and 42 lb. Foreign, 38 and 40 lb. Rye and Maize, 60 lb. Buckwheat, 52 lb. to the bushel. Grain of all kinds is frequently sold by the stone of 14 lb.

Liquid Measure

The Gill contains 8.665 cubic inches.
The Pint contains 4 gills or 34.660 inches.
Quart=2 pints= 8 gills.
Gallon=4 quarts=32 gills.

Pin=4½ gallons or ⅛ barrel.	Gals.	Qts.	Pts.
Firkin or Quarter Barrel	9	36	72
Anker (10 gallons)	10	40	80
Kilderkin, rundlet or ½ barrel	18	72	144
Barrel	36	144	288
Tierce (42 gallons)	42	168	336
Hogshead of Ale, (1½ barrels)	54	216	432
Puncheon	72	288	576
Butt of Ale	108	432	864

Wool.

Clove =7 lb.
Stone =2 cloves 14 lb.
Tod =2 stones 1 qr.
Wey =6½ tod 1 cwt, 2 qr. 14 lb.
Pack =240 lb.
Sack =2 weys 13 qr.
Last =12 sacks 39 cwt.

British Weights and Measures—Continued

Measure of Length

Mile Geographical, Admiralty Nautical Mile, 6,080 feet = 1,013⅓ fathoms = 1.15 Mile Statute.
League=3 miles.
Degree=60 Geographical or 69.121 statute miles.

Inch	=72 points, 12 lines.
Nail, 1/16	= 2 inches.
Palm	= 3 inches.
Hand	= 4 inches.
Link	= 7.92 inches.
Quarter (or a Span)	= 9 inches.
Foot	=12 inches.
Cubit	=18 inches.
Yard	=36 inches.
Pace, military	= 2 feet, 6 inches.
Pace, geometrical	= 5 feet.
Fathom	= 6 feet.
Rod, pole or perch	= 5½ yards.
Chain (100 links)	=22 yards (4 poles).
Cable's length	=100 fathoms, 600 feet.
Furlong	=40 rods, 220 yards.

Mile=8 furlongs, 80 chains, 320 rods, 880 fathoms, 1,760 yards, 5,280 feet, 63,360 inches.

Although no longer sold by that measure, calicos, etc., are sometimes said to be "Ell wide," the English Ell being 1¼ yard, the Flemish Ell ¾ yard, and the French Ell 1½ yard.

The old Scottish mile was 5,920 feet; ten Scots miles being about equal to 11¼ statute miles. Irish mile is 6,720 feet; eleven Irish miles being equal to 14 statute miles.

Square, Surface or Land Measure

The Square Foot contains 144 square inches.
Yard=9 feet=1,296 inches.
Rod, pole or perch=30¼ yards=172¼ feet.
Chain=16 rods=484 yards=4,356 feet.
Rood=40 rods=1,210 yards=10,890 feet.
Acre=4 roods=160 rods=4,840 yards.
Yard of Land=30 acres=120 roods.
Hide=100 acres=400 roods.
Mile=640 acres=2,560 roods=6,400 chains=102,400 rods, poles or perches or 3,097,600 square rods.
An acre, roughly stated, has four equal sides of 69½ yards; accurate measurement gives each side 208.71 feet.
The sides of a square half acre would be 147.581 feet, and of a square quarter-acre 104.355 feet.

The above Imperial Measure is now employed in the United Kingdom, in Canada, Australia, and the Colonies generally, also in the United States; but occasionally some older measurements are referred to. Of these—

The Lancashire and Irish Acre, each of 160 perches, contain 7,840 square yards, equal to 1.619835 Statute. 1 Statute=0.617347 Lancashire or Irish.

The Cheshire Acre of 160 perches each containing 64 square yards= 10,240 square yards.

The Cunningham Acre, equal to 1.291322 Statute, or 1 Statute Acre, or 1 Statute Acre is equal to 0.7744 Cunningham.

The Scottish Acre= 1.261183 Statute (nearly 6,104 square yards).

Switches and Frogs

Rules for the Use of Roadmasters

(By D. H. Lovell, C. E. From "The Official Railway List.)

Split Switches

The rule for the theoretical lead of a split switch for any gauge is: Twice the gauge of the track multiplied by the number or proportion of the frog; or, for 4 ft. 8½ in. and 4 ft. 9 in. gauges the lead is 9½ times number of frog, and for 5 ft. gauge 10 times number of frog.

Theoretical Leads

3 ft. Gauge		4 ft. 8½ in. Gauge			4 ft. 9 in. Gauge			5 ft. Gauge	
No. Frog	Lead	No. Frog	Lead		No. Frog	Lead		No. Frog	Lead
	Ft.		Ft.	In.		Ft.	In.		Ft.
4---	24	6---	56	6	6---	57	0	6---	60
5---	30	7---	65	11	7---	66	6	7---	70
6---	36	8---	75	4	8---	76	0	8---	80
7---	42	9---	84	9	9---	85	6	9---	90
8---	48	10---	94	2	10---	95	0	10---	100
9---	54	11---	103	7	11---	104	6	11---	110
10---	60	12---	113	0	12---	114	0	12---	120
11---	66	15---	141	3	15---	142	6	15---	150

In practice the above are found to be too long. For shortened leads, which will be found to work well in practice, the following rule is given; For 4 ft. 8½ in. and 4 ft. 9 in. gauges the lead for all the frogs up to and including a No. 6 is 9½ times No. of frog; for Nos. 7 and 8, 9 times No. of frog; for Nos. 9 and 10, 8½ times No. of frog; and for all above No. 10, 8 times No, of frog.

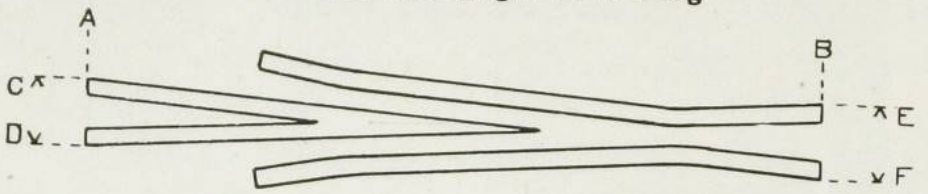
For 5 feet gauge add ½ to each of the preceding multipliers. No. 6 multiplied by 9½ will then be No. 6 multiplied by 10 equals 60 ft. which is the lead for No. 6 frog and 5 ft. gauge.

Shortened Leads

4 ft. 8½ in. and 4 ft. 9 in. Gauges				5 ft. Gauge			
No.Frog	Lead	No.Frog	Lead	No.Frog	Lead	No.Frog	Lead
6x9½	=57′ 0″	10x8½	= 85′	6x10	=60′ 0″	10x9	= 90′ 0″
7x9	=63′	11x8	= 88′	6x 9½	=66′ 6″	11x8½	= 93′ 6″
8x9	=72′	12x8	= 96′	8x 9½	=76′	12x8½	=102′
9x8½	=76′ 6″	15x8	=120′	9x 9	=81′	15x8½	=127′ 6″

The above shortened leads may be varied from when it is expedient to [illegible] to avoid waste of rail by cutting or to suit the material.

To Find the Angle of a Frog



Divide the distance A B by the sum of the distances C D and E F. For example, suppose A B to equal 72 inches, C D 8 inches, and E F 4 inches, then 72 divided by 12 equals 6. Angle or spread of frog is 1 in 6.

Table for Putting in Frogs and Switches

Proportion of Frog	Length of Frog	Angle of Frog	Radius of Curve	Distance from Head Block to Point of Frog	Crotch Frog: Proportion of Frog	Crotch Frog: Length of Frog	Crotch Frog: Distance from Head Block to Point of Frog	
1 to 4	5 feet	14° 15′	165 feet	28 feet	1 to 3	4 ft.	17 feet	Gauge 5 feet. 5-inch throw.
1 " 5	5 "	11° 25′	254 "	35 "	1 " $2\frac{2}{3}$	4 "	21 "	
1 " 6	6 "	9° 32′	365 "	42 "	1 " $4\frac{1}{3}$	5 "	25 "	
1 " 7	7 "	8° 10′	566 "	48 "	1 " 5	5 "	28 "	
1 " 8	8 "	7° 09′	642 "	57 "	1 " $5\frac{2}{3}$	5 " 8 in.	34 "	
1 " 9	9 "	6° 21′	811 "	64 "	1 " $6\frac{1}{3}$	6 " 4 "	38 "	
1 " 10	10 "	5° 44′	1005 "	71 "	1 " 7	7 "	41 "	
1 " 11	11 "	5° 12′	1210 "	78 "	1 " $7\frac{2}{3}$	7 " 8 in.	45 "	
1 " 12	12 "	4° 46′	1400 "	86 "	1 " $8\frac{1}{3}$	8 " 4 "	50 "	
1 " 4	5 "	14° 15′	155 "	26 "	1 " 3	4 "	16 "	Gauge 4′ $8\frac{1}{2}$″ 5-inch throw.
1 " 5	5 "	11° 2′	239 "	32 "	1 " $3\frac{2}{3}$	4 "	20 "	
1 " 6	6 "	9° 32′	345 "	39 "	1 " $4\frac{1}{3}$	5 "	23 "	
1 " 7	7 "	8° 10′	431 "	46 "	1 " 5	5 "	28 "	
1 " 8	8 "	7° 09′	606 "	52 "	1 " $5\frac{2}{3}$	5 " 8 in.	31 "	
1 " 9	9 "	6° 21′	764 "	59 "	1 " $6\frac{1}{3}$	6 " 4 "	35 "	
1 " 10	10 "	5° 44′	979 "	65 "	1 " 7	7 "	37 "	
1 " 11	11 "	5° 12′	1096 "	73 "	1 " $7\frac{2}{3}$	7 " 8 "	42 "	
1 " 12	12 "	4° 46′	1246 "	80 "	1 " $8\frac{1}{3}$	8 " 4 "	46 "	
1 " 4	4 "	14° 15′	102 "	14 "	1 " 3	4 "	8 "	Gauge 3 feet. 5-inch throw.
1 " 5	5 "	11° 25′	154 "	19 "	1 " $3\frac{2}{3}$	4 "	11 "	
1 " 6	6 "	9° 32′	220 "	23 "	1 " $4\frac{1}{3}$	4 "	13 "	
1 " 7	7 "	8° 10′	296 "	27 "	1 " 5	5 "	15 "	
1 " 8	8 "	7° 09′	388 "	32 "	1 " $5\frac{2}{3}$	5 "	18 "	
1 " 9	9 "	6° 21′	486 "	36 "	1 " $6\frac{1}{3}$	6 "	20 "	
1 " 10	10 "	5° 44′	606 "	41 "	1 " 7	7 "	22 "	
1 " 11	11 "	5° 12′	732 "	45 "	1 " $7\frac{2}{3}$	7 "	25 "	
1 " 12	12 "	4° 46′	66 "	50 "	1 " $8\frac{1}{3}$	8 "	27 "	

For Split Switch, place heel of switch same distance from point of frog as head block:

8 feet switch points are suitable for frogs 1 to 4, 1 to 5, or 1 to 6
10 " " " " " " " 1 to 7, 1 to 8, or 1 to 9
15 " " " " " " " 1 to 10, 1 to 11, or 1 to 12

Stub Switches

The lead for a stub switch for 4 feet 8½ inch and 4 feet 9 inch gauges is 6¾ (6.75) times number of frog for 5 inch throw, and 6½ (6.5) times number of frog for 5¾ inch throw. For 5 feet gauge and 5 inch or 5¾-inch throw the lead is 7 times number of frog. The stub lead should not be shortened: it and the length of switch rail should be equal, or nearly so, to the full theoretical lead.

5-inch Throw		5¾-inch Throw		5 and 5¾-inch Throw	
4 feet 8½ inch and 4 feet 9 inch Gauges		4 feet 8½ inch and 4 feet 9-inch Gauges		5 foot Gauge	
No. Frog	Lead	No. Frog	Lead	No. Frog	Lead
6x6¾	=40′ 6″	6x6½	=39′ 0″	6x7	=42′
7x6¾	=47′ 3″	7x6½	=45′ 6″	7x7	=49′
8x6¾	=54′	8x6½	=52′	8x7	=56′
9x6¾	=60′ 9″	9x6½	=58′ 6″	9x7	=63′
10x6¾	=67′ 6″	10x6½	=65′	10x7	=70′

For Length of Moving Rail—Stub Switch

For 4 feet 8½ inch and 4 feet 9 inch gauges and 5 inch throw the length of moving rail is 2¾ (2.75) times No. of frog. For 4 feet 8½ inch and 4 feet 9 inch gauges and 5¾ inch throw; and for 5 feet gauge and 5 and 5¾ inch throw it is 3 times No. of frog.

4 feet 8½-inch and 4 feet 9-inch Gauges and 5-inch throw 5 feet Gauge and 5 and 5¾-inch Throws		4 feet 8½ inch and 4 feet 9-inch Gauges and 5¾-inch Throw 5 feet Gauge and 5 and 5¾-inch Throws	
2¾ (2.75) Times No. of Frog		3 Times No. of Frog	
No. Frog		No. Frog	
6x2¾	=16 ft. 6 in. moving rail	6x3	=18 ft. moving rail
7x2¾	=19 ft. 3 in. " "	7x3	=21 ft. " "
8x2¾	=22 ft. " "	8x3	=24 ft. " "
9x2¾	=24 ft. 9 in. " "	9x3	=27 ft. " "
10x2¾	=27 ft. 6 in. " "	10x3	=30 ft. " "

As all the preceding is presented in a way to be intelligible and useful to the trackman, it is hardly to be expected that it will check theoretically, but it will be found to nearly do so.

Crossing Between Parallel Tracks

From the distance between gauge lines of parallel tracks subtract the gauge of the track; multiply the remainder by the number of the frog, and it will give the distance between the frog points measured along with, not diagonally across, the parallel tracks. The distance between gauge lines to be taken as the distance between the tracks.

Example.—Distance between tracks, 7 feet; 4 feet 8½ inch gauge and No. 10 frog. 7 feet—4 feet 8½ inches = 2 feet 3½ inches. 2 feet 3½ inches x 10 = 22 feet 11 inches, the distance between frog points.

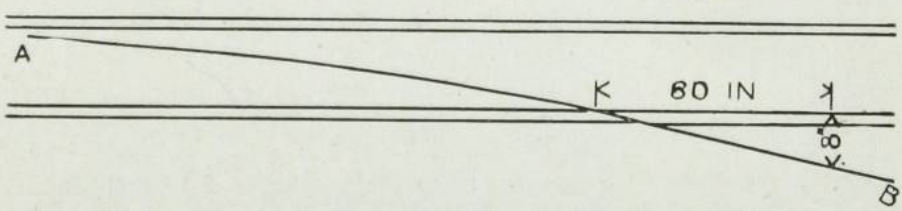
Table for the Elevation of the Outer Rail on Curves

The following table, calculated by A. Mordecai, C. E., is intended to serve for the principal gauge used in this country, viz.: 4 feet 8½ inches. The proper elevation is calculated for nine different speeds, from 15 to 60 miles an hour, and for curves from 30 minutes to 35 degrees radius.

Degree of Curvature	Rate of Speed in Miles per hour.								
	15	20	25	30	35	40	45	50	60
	In.	In.	In.	In.	In.	In.	In.	In.	In.
30′	1/16	1/8	3/16	1/4	3/8	1/2	11/16	13/16	1 1/8
1° 00′	1/8	1/4	7/16	5/16	11/16	1 1/16	1 5/16	1 5/8	2 3/8
1° 30′	3/16	3/8	5/8	7/8	1 3/16	1 9/16	2	2 1/2	3 1/2
2° 00′	5/16	1/2	13/16	1 1/8	1 5/8	2 1/8	2 11/16	3 1/4	4 5/8
2° 30′	3/8	11/16	1	1 1/2	2	2 11/16	3 5/16	4 1/16	5 15/16
3° 00′	7/16	13/16	1 1/4	1 3/4	2 7/16	3 1/8	4	4 15/16	7
3° 30′	1/2	15/16	1 7/16	2 1/16	2 13/16	3 11/16	4 5/8	5 3/4	8 5/16
4° 00′	9/16	1 1/16	1 5/8	2 3/8	3 1/4	4 3/16	5 5/16	6 1/4	9 7/16
4° 30′	11/16	1 3/16	1 7/8	2 5/8	3 5/8	4 11/16	6	7 3/8	10 9/16
5° 00′	3/4	1 5/16	2 1/16	3	4	5 1/4	6 5/8	8 3/16	11 7/8
6° 00′	7/8	1 9/16	2 7/16	3 1/2	4 13/16	6 5/16	8	9 7/8	14 1/16
7° 00′	1	1 7/8	2 7/8	4 1/8	5 5/8	7 3/8	9 1/4	11 1/2	16 1/2
8° 00′	1 3/16	2 1/8	3 5/16	4 11/16	6 7/16	8 3/8	10 5/8	13 1/2	18 7/8
9° 00′	1 5/16	2 3/8	3 11/16	5 5/16	7 1/4	9 7/16	11 15/16	14 3/4	21 5/16
10° 00′	1 1/2	2 5/8	4 1/8	5 7/8	8	10 1/2	13 1/4	16 3/8	23 1/2
12° 00′	1 3/4	3 1/8	4 15/16	7 1/16					
15° 00′	2 1/4	3 15/16	6 1/8	9 1/16					
18° 00′	2 11/16	4 11/16	7 3/8	10 9/16					
20° 00′	2 15/16	5 1/4	8 3/16	11 3/4					
25° 00′	3 13/16	6 13/16	10 5/8	15 5/16					
30° 00′	4 3/8	7 13/16	12 3/16	17 1/2					
35° 00′	5 1/16	9 1/16	14 1/4	20 5/16					

To Find the Angle of a Frog Required for any Turnout

Lay out the line AB, find where it measures 8 inches from the running side of main rail after crossing it, mark that point and measure the distance from there to where it intersects the running side of the main rail, and divide the distance by the 8 inches, the result will be the angle of frog. For example, suppose the line AB to be 8 inches from main rail at a point 60 inches from the point of intersection, then 60 divided by 8 equals 7½. Frog required is No. 7½ or 1 to 7½.



To Find the Degree or Radius of a Curve

Stretch tight a fifty-foot tape line on the inner side of the rail, measure the distance between the center of the line and the rail. The radius and degree of curvature corresponding to distance may be found in the following table:

Degree	Radius in Feet	Distance Between Line and Rail in Inches	Degree	Radius in Feet	Distance Between Line and Rail in Inches
.30	11460	$\frac{7}{32}$	11°	522	$7\frac{13}{64}$
1°	5730	$\frac{21}{32}$	12°	478	$7\frac{7}{8}$
2°	2865	$1\frac{5}{16}$	13°	442	$8\frac{1}{2}$
3°	1910	$1\frac{31}{32}$	14°	410	$9\frac{11}{64}$
4°	1433	$2\frac{5}{8}$	15°	383	$9\frac{51}{64}$
5°	1146	$3\frac{9}{32}$	16°	359	$10\frac{1}{2}$
6°	955	$3\frac{15}{16}$	17°	338	$11\frac{7}{64}$
7°	819	$4\frac{9}{64}$	18°	320	$11\frac{25}{32}$
8°	717	$5\frac{1}{4}$	19°	303	$12\frac{13}{32}$
9°	637	$5\frac{57}{64}$	20°	288	$13\frac{1}{16}$
10°	574	$6\frac{17}{32}$			

Table for Widening Gauge on Curves

Degree of Curve	Gauge of Track	Inches which Standard Gauge 4 ft. 8½ in. is Widened	Degree of Curve	Gauge of Track	Inches which Standard Gauge 4 ft. 8½ in. is Widened
1°	4 ft. $8\frac{5}{8}$ in.	$\frac{1}{8}$ in.	11°	4 ft. 9 in	$\frac{1}{2}$ in.
2°	4 " $8\frac{5}{8}$ "	$\frac{1}{8}$ "	12°	4 " $9\frac{1}{8}$ "	$\frac{5}{8}$ "
3°	4 " $8\frac{3}{4}$ "	$\frac{1}{4}$ "	13°	4 " $9\frac{1}{8}$ "	$\frac{5}{8}$ "
4°	4 " $8\frac{3}{4}$ "	$\frac{1}{4}$ "	14°	4 " $9\frac{1}{8}$ "	$\frac{5}{8}$ "
5°	4 " $8\frac{3}{4}$ "	$\frac{1}{4}$ "	15°	4 " $9\frac{1}{4}$ "	$\frac{3}{4}$ "
6°	4 " $8\frac{7}{8}$ "	$\frac{3}{8}$ "	16°	4 " $9\frac{1}{4}$ "	$\frac{3}{4}$ "
7°	4 " $8\frac{7}{8}$ "	$\frac{3}{8}$ "	17°	4 " $9\frac{1}{4}$ "	$\frac{3}{4}$ "
8°	4 " $8\frac{7}{8}$ "	$\frac{3}{8}$ "	18°	4 " $9\frac{3}{8}$ "	$\frac{7}{8}$ "
9°	4 " 9 "	$\frac{1}{2}$ "	19°	4 " $9\frac{3}{8}$ "	$\frac{7}{8}$ "
10°	4 " 9 "	$\frac{1}{2}$ "	20°	4 " $9\frac{1}{2}$ "	1 "

Middle Ordinates for Curving Rails

(Ordinates at the quarters are ¾ of middle ordinates)

Degree of Curve	LENGTH OF RAILS (Feet)											Degree of Curve
	30	28	26	24	22	20	18	16	14	12	10	
	INCHES											
1°	1/4	3/16	3/16	1/8	1/8	1/8	1/16	1/16	1/16	1/16	1/16	1°
2°	1/2	7/16	3/8	5/16	1/4	1/4	3/16	1/8	1/8	1/16	1/16	2°
3°	11/16	5/8	9/16	7/16	3/8	5/16	1/4	1/4	3/16	1/8	1/16	3°
4°	15/16	7/8	3/4	5/8	1/2	1/2	3/8	5/16	1/4	3/16	1/8	4°
5°	1 3/16	1 1/16	7/8	3/4	5/8	9/16	7/16	3/8	1/4	3/16	1/8	5°
6°	1 7/16	1 1/4	1 1/16	15/16	13/16	5/8	1/2	7/16	5/16	1/4	3/16	6°
7°	1 11/16	1 1/2	1 1/4	1 1/16	7/8	3/4	5/8	1/2	3/8	1/4	3/16	7°
8°	1 15/16	1 11/16	1 7/16	1 3/16	1 1/16	7/8	11/16	9/16	1/2	5/16	1/4	8°
9°	2 1/8	1 7/8	1 5/8	1 3/8	1 1/8	15/16	3/4	5/8	1/2	3/8	1/4	9°
10°	2 3/8	2 1/16	1 13/16	1 1/2	1 5/16	1 1/16	7/8	11/16	9/16	3/8	1/4	10°
11°	2 5/8	2 1/4	2—	1 11/16	1 7/16	1 3/16	15/16	3/4	5/8	7/16	5/16	11°
12°	2 7/8	2 1/2	2 3/16	1 13/16	1 9/16	1 1/4	1 1/16	7/8	5/8	1/2	5/16	12°
13°	3 1/16	2 11/16	2 5/16	2—	1 11/16	1 3/8	1 1/8	15/16	11/16	1/2	3/8	13°
14°	3 5/16	2 7/8	2 1/2	2 1/8	1 13/16	1 1/2	1 3/16	1—	3/4	9/16	3/8	14°
15°	3 9/16	3 1/8	2 11/16	2 1/4	1 15/16	1 9/16	1 5/16	1 1/16	13/16	5/8	7/16	15°
16°	3 3/4	3 5/16	2 7/8	2 7/16	2 1/16	1 11/16	1 3/8	1 1/8	7/8	5/8	7/16	16°
17°	4—	3 1/2	3 1/16	2 9/16	2 3/16	1 13/16	1 7/16	1 3/16	7/8	11/16	7/16	17°
18°	4 1/4	3 11/16	3 3/16	2 11/16	2 5/16	1 7/8	1 9/16	1 1/4	15/16	11/16	1/2	18°
19°	4 1/2	3 7/8	3 3/8	2 7/8	2 7/16	2—	1 5/8	1 5/16	1—	3/4	1/2	19°
20°	4 3/4	4 1/8	3 9/16	3—	2 9/16	2 1/8	1 11/16	1 3/8	1 1/16	13/16	9/16	20°
21°	4 15/16	4 5/16	3 3/4	3 3/16	2 11/16	2 3/16	1 13/16	1 7/16	1 1/8	7/8	9/16	21°
22°	5 3/16	4 1/2	3 15/16	3 5/16	2 13/16	2 5/16	1 7/8	1 1/2	1 3/16	7/8	9/16	22°
23°	5 7/16	4 11/16	4 1/16	3 7/16	2 15/16	2 3/8	1 15/16	1 9/16	1 3/16	15/16	5/8	23°
24°	5 5/8	4 15/16	4 1/4	3 5/8	3 1/16	2 1/2	2 1/16	1 11/16	1 1/4	15/16	5/8	24°
25°	5 7/8	5 1/8	4 7/16	3 3/4	3 3/16	2 5/8	2 1/8	1 3/4	1 5/16	1—	11/16	25°
26°	6 1/16	5 5/16	4 5/8	3 7/8	3 5/16	2 11/16	2 3/16	1 13/16	1 3/8	1—	11/16	26°
27°	6 5/16	5 1/2	4 3/4	4 1/16	3 7/16	2 13/16	2 5/16	1 7/8	1 7/16	1 1/16	11/16	27°
28°	6 9/16	5 11/16	4 15/16	4 3/16	3 9/16	2 15/16	2 3/8	1 15/16	1 7/16	1 1/8	3/4	28°
29°	6 13/16	5 7/8	5 1/8	4 3/8	3 5/8	3—	2 7/16	2—	1 1/2	1 1/8	3/4	29°

Middle Ordinates

Rad.	MIDDLE ORDINATE			CH. OF 30° ARC.
	20° CH.	30° CH.	30° ARC.	
30	1° 8 9/16"	4° 0 1/4"	3° 8 1/16"	28° 9 3/16"
31	1° 7 7/8"	3° 10 7/16"	3° 6 11/16"	28° 10 1/8"
32	1° 7 1/4"	3° 8 13/16"	3° 5 7/16"	28° 10 15/16"
33	1° 6 5/8"	3° 7 5/16"	3° 4 3/16"	28° 11 3/4"
34	1° 6 1/16"	3° 5 7/8"	3° 3 1/16"	29° 0 7/16"
35	1° 5 1/2"	3° 4 1/2"	3° 2 "	29° 1 1/16"
36	1° 5 "	3° 3 5/16"	3° 0 15/16"	29° 1 11/16"
37	1° 4 1/2"	3° 2 1/8"	3° 0 "	29° 2 1/4"
38	1° 4 1/16"	3° 1 "	2° 11 1/16"	29° 2 3/4"
39	1° 3 5/8"	3° 0 "	2° 10 3/16"	29° 3 3/16"
40	1° 3 1/4"	2° 11 "	2° 9 3/8"	29° 3 5/8"
41	1° 2 7/8"	2° 10 1/8"	2° 8 9/16"	29° 4 "
42	1° 2 1/2"	2° 9 1/4"	2° 7 13/16"	29° 4 3/8"
43	1° 2 1/8"	2° 8 7/16"	2° 7 1/16"	29° 4 3/4"
44	1° 1 13/16"	2° 7 5/8"	2° 6 3/8"	29° 5 1/16"
45	1° 1 1/2"	2° 6 7/8"	2° 5 3/4"	29° 5 3/8"
46	1° 1 3/16"	2° 6 3/16"	2° 5 1/16"	29° 5 5/8"
47	1° 0 15/16"	2° 5 1/2"	2° 4 1/2"	29° 5 15/16"
48	1° 0 5/8"	2° 4 7/8"	2° 3 7/8"	29° 6 3/16"
49	1° 0 3/8"	2° 4 1/4"	2° 3 5/16"	29° 6 3/8"
50	1° 0 1/8"	2° 3 5/8"	2° 2 13/16"	29° 6 5/8"
51	0° 11 7/8"	2° 3 1/16"	2° 2 1/4"	29° 6 13/16"
52	0° 11 5/8"	2° 2 1/2"	2° 1 13/16"	29° 7 "
53	0° 11 7/16"	2° 2 "	2° 1 5/16"	29° 7 3/16"
54	0° 11 3/16"	2° 1 1/2"	2° 0 13/16"	29° 7 3/8"
55	0° 11 "	2° 1 "	2° 0 3/8"	29° 7 7/16"
56	0° 10 13/16"	2° 0 9/16"	1° 11 15/16"	29° 7 11/16"
57	0° 10 5/8"	2° 0 1/8"	1° 11 9/16"	29° 7 7/8"
58	0° 10 7/16"	1° 11 11/16"	1° 11 1/8"	29° 8 "
59	0° 10 1/4"	1° 11 1/4"	1° 10 3/4"	29° 8 1/8"
60	0° 10 1/16"	1° 10 7/8"	1° 10 3/8"	29° 8 1/4"
61	0° 9 7/8"	1° 10 1/2"	1° 10 "	29° 8 3/8"
62	0° 9 3/4"	1° 10 1/8"	1° 9 11/16"	29° 8 1/2"
63	0° 9 9/16"	1° 9 3/4"	1° 9 5/16"	29° 8 5/8"
64	0° 9 7/16"	1° 9 3/8"	1° 9 "	29° 8 11/16"
65	0° 9 5/16"	1° 9 "	1° 8 11/16"	29° 8 13/16"
66	0° 9 1/8"	1° 8 3/4"	1° 8 3/8"	29° 8 7/8"
67	0° 9 "	1° 8 3/8"	1° 8 1/16"	29° 9 "
68	0° 8 7/8"	1° 8 1/8"	1° 7 3/4"	29° 9 1/16"
69	0° 8 3/4"	1° 7 13/16"	1° 7 1/2"	29° 9 3/16"
70	0° 8 5/8"	1° 7 1/2"	1° 7 3/16"	29° 9 1/4"
71	0° 8 1/2"	1° 7 3/16"	1° 6 15/16"	29° 9 5/16"
72	0° 8 3/8"	1° 6 15/16"	1° 6 11/16"	29° 9 3/8"
73	0° 8 1/4"	1° 6 11/16"	1° 6 7/16"	29° 9 1/2"
74	0° 8 1/8"	1° 6 7/16"	1° 6 3/16"	29° 9 9/16"
75	0° 8 1/16"	1° 6 3/16"	1° 5 15/16"	29° 9 5/8"
76	0° 7 15/16"	1° 5 15/16"	1° 5 11/16"	29° 9 11/16"
77	0° 7 13/16"	1° 5 11/16"	1° 5 1/2"	29° 9 3/4"

Middle Ordinates—Continued

Rad.	MIDDLE ORDINATE			CH. OF 30° ARC.
	20° CH.	30° CH.	30° ARCH.	
78	0° 7 3/4"	1° 5 7/16"	1° 5 1/4"	29° 9 13/16"
79	0° 7 5/8"	1° 5 1/4"	1° 5 1/16"	29° 9 7/8"
80	0° 7 1/2"	1° 5"	1° 4 13/16"	29° 9 7/8"
81	0° 7 7/16"	1° 4 13/16"	1° 4 5/8"	29° 9 15/16"
82	0° 7 3/8"	1° 4 9/16"	1° 4 7/16"	29° 10"
83	0° 7 1/4"	1° 4 3/8"	1° 4 1/4"	29° 10 1/16"
84	0° 7 3/16"	1° 4 3/16"	1° 4"	29° 10 1/16"
85	0° 7 1/16"	1° 4"	1° 3 13/16"	29° 10 1/8"
86	0° 7"	1° 3 13/16"	1° 3 5/8"	29° 10 3/16"
87	0° 6 15/16"	1° 3 5/8"	1° 3 1/2"	29° 10 1/4"
88	0° 6 13/16"	1° 3 7/16"	1° 3 5/16"	29° 10 1/4"
89	0° 6 3/4"	1° 3 1/4"	1° 3 1/16"	29° 10 5/16"
90	0° 6 11/16"	1° 3 1/16"	1° 2 15/16"	29° 10 5/16"
91	0° 6 5/8"	1° 2 7/8"	1° 2 13/16"	29° 10 3/8"
92	0° 6 9/16"	1° 2 3/4"	1° 2 5/8"	29° 10 3/8"
93	0° 6 1/2"	1° 2 5/8"	1° 2 1/2"	29° 10 7/16"
94	0° 6 3/8"	1° 2 7/16"	1° 2 5/16"	29° 10 1/2"
95	0° 6 5/16"	1° 2 1/4"	1° 2 3/16"	29° 10 1/2"
96	0° 6 1/4"	1° 2 1/8"	1° 2 1/16"	29° 10 9/16"
97	0° 6 3/16"	1° 2"	1° 1 7/8"	29° 10 9/16"
98	0° 6 1/8"	1° 1 7/8"	1° 1 3/4"	29° 10 5/8"
99	0° 6 1/16"	1° 1 3/4"	1° 1 5/8"	29° 10 5/8"
100	0° 6"	1° 1 9/16"	1° 1 1/2"	29° 10 5/8"
105	0° 5 3/4"	1° 0 15/16"	1° 0 13/16"	29° 10 3/4"
110	0° 5 7/16"	1° 0 5/16"	1° 0 1/4"	29° 10 7/8"
115	0° 5 1/4"	0° 11 13/16"	0° 11 3/4"	29° 11"
120	0° 5"	0° 11 5/16"	0° 11 1/4"	29° 11 1/16"
125	0° 4 13/16"	0° 10 7/8"	0° 10 13/16"	29° 11 1/8"
130	0° 4 5/8"	0° 10 7/16"	0° 10 3/8"	29° 11 3/16"
135	0° 4 7/16"	0° 10 1/16"	0° 10"	29° 11 1/4"
140	0° 4 5/16"	0° 9 11/16"	0° 9 5/8"	29° 11 5/16"
145	0° 4 1/8"	0° 9 3/8"	0° 9 5/16"	29° 11 3/8"
150	0° 4"	0° 9"	0° 9"	29° 11 3/8"
155	0° 3 7/8"	0° 8 11/16"	0° 8 11/16"	29° 11 7/16"
160	0° 3 3/4"	0° 8 7/16"	0° 8 7/16"	29° 11 7/16"
165	0° 3 5/8"	0° 8 3/16"	0° 8 3/16"	29° 11 1/2"
170	0° 3 1/2"	0° 7 15/16"	0° 7 15/16"	29° 11 9/16"
175	0° 3 7/16"	0° 7 11/16"	0° 7 11/16"	29° 11 9/16"
180	0° 3 5/16"	0° 7 1/2"	0° 7 1/2"	29° 11 9/16"
185	0° 3 1/4"	0° 7 5/16"	0° 7 5/16"	29° 11 5/8"
190	0° 3 3/16"	0° 7 1/16"	0° 7 1/16"	29° 11 5/8"
195	0° 3 1/16"	0° 6 15/16"	0° 6 15/16"	29° 11 11/16"
200	0° 3"	0° 6 3/4"	0° 6 3/4"	29° 11 11/16"
205	0° 2 15/16"	0° 6 9/16"	0° 6 9/16"	29° 11 11/16"
210	0° 2 7/8"	0° 6 7/16"	0° 6 7/16"	29° 11 11/16"
215	0° 2 13/16"	0° 6 1/4"	0° 6 1/4"	29° 11 11/16"
220	0° 2 3/4"	0° 6 1/8"	0° 6 1/8"	29° 11 11/16"
225	0° 2 11/16"	0° 6"	0° 6"	29° 11 3/4"

Rails

Weight per yard	Tons per mile of Single Track	Weight per yard	Tons per mile of Single Track
8 lbs.	$12\frac{1280}{2240}$	65 lbs.	$102\frac{320}{2240}$
12 "	$18\frac{1920}{2240}$	68 "	$106\frac{1920}{2240}$
16 "	$25\frac{320}{2240}$	70 "	110
25 "	$39\frac{640}{2240}$	72 "	$113\frac{320}{2240}$
30 "	$47\frac{320}{2240}$	75 "	$117\frac{1920}{2240}$
35 "	55	76 "	$119\frac{960}{2240}$
40 "	$62\frac{1920}{2240}$	78 "	$122\frac{1280}{2240}$
45 "	$70\frac{1600}{2240}$	80 "	$125\frac{1600}{2240}$
50 "	$78\frac{1280}{2240}$	85 "	$133\frac{1280}{2240}$
52 "	$81\frac{1600}{2240}$	90 "	$141\frac{960}{2240}$
56 "	88	95 "	$149\frac{640}{2240}$
57 "	$89\frac{1280}{2240}$	100 "	$157\frac{320}{2240}$
60 "	$94\frac{640}{2240}$	105 "	155
62 "	$97\frac{960}{2240}$	110 "	$172\frac{1920}{2240}$
64 "	$100\frac{1280}{2240}$		

To find the number of tons (of 2,240 lbs.) per mile of single track, multiply the pounds per yard by 11 and divide by 7.

Cross Ties

Per Mile of Single Track

From center to center, 18 inches.....3,520 ties
From center to center, 24 inches.....2,641 ties
From center to center, 27 inches.....2,348 ties
From center to center, 30 inches.....2,113 ties
From center to center, 33 inches.....1,921 ties
From center to center, 36 inches.....1,761 ties

Fish Plates and Bolts

Length of Rail	No. Joints per mile	No. Fish Plates per mile	No. Bolts per mile
24 feet	440	880	1760
25 feet	422	844	1668
26 feet	406	812	1624
27 feet	391	782	1564
28 feet	377	754	1508
30 feet	352	704	1408
33 feet	320	640	1280
45 feet	235	470	940
60 feet	176	352	704

Average Number of Track Bolts in a Keg of 200 Pounds

$\frac{7}{8}$ x $3\frac{1}{2}$ with hexagon nuts ..... 170 bolts
$\frac{3}{4}$ x $3\frac{1}{2}$ with square nuts ..... 210 bolts
$\frac{3}{4}$ x $3\frac{3}{4}$ with hexagon nuts ..... 220 bolts
$\frac{5}{8}$ x $2\frac{1}{2}$ with square nuts ..... 370 bolts
$\frac{1}{2}$ x $2\frac{1}{2}$ with square nuts ..... 650 bolts
$\frac{1}{2}$ x 3 with square nuts ..... 600 bolts

Railroad Spikes

Size measured under head	Average No. per keg of 200 lbs.	Ties two feet between centres, four spikes per tie, makes per mile	Rails used, weight per yard
$5\frac{1}{2}$ x $\frac{9}{16}$	375	5870 lbs.—$29\frac{3}{8}$ kegs	45 to 70
5 x $\frac{9}{16}$	400	5170 lbs.—26 kegs	40 to 56
5 x $\frac{1}{2}$	450	4660 lbs.—$23\frac{1}{3}$ kegs	35 to 40
$4\frac{1}{2}$ x $\frac{1}{2}$	530	3960 lbs.—20 kegs	28 to 35
4 x $\frac{1}{2}$	600	3520 lbs.—$17\frac{3}{8}$ kegs	24 to 35
$4\frac{1}{2}$ x $\frac{7}{16}$	680	3110 lbs.—$15\frac{1}{2}$ kegs	20 to 30
4 x $\frac{7}{16}$	720	2910 lbs.—$14\frac{3}{4}$ kegs	
$3\frac{1}{2}$ x $\frac{7}{16}$	900	2350 lbs.—11 kegs	16 to 25
4 x $\frac{3}{8}$	1000	2090 lbs.—$10\frac{1}{2}$ kegs	
$3\frac{1}{2}$ x $\frac{3}{8}$	1190	1780 lbs.—9 kegs	16 to 20
3 x $\frac{3}{8}$	1240	1710 lbs.—$8\frac{1}{2}$ kegs	
$2\frac{1}{2}$ x $\frac{3}{8}$	1342	1575 lbs.—$7\frac{7}{8}$ kegs	12 to 16

USEFUL INFORMATION

To find circumference of a circle, multiply diameter by 3.1416.

To find diameter of a circle, multiply diameter by .3'831.

To find area of a circle, multiply square of diameter by .7854.

To find area of a triangle, multiply base by ½ perpendicular height.

To find surface of a ball, multiply square of diameter by 3.1416.

To find solidity of a sphere, multiply cube of diameter by .5236.

To find side of an equal square, multiply diameter by .8862.

To find cubic inches in a ball, multiply cube of diameter by .5236.

Doubling the diameter of a pipe increases its capacity four times.

A gallon of water (U.S. standard) weighs 8⅓ lbs. and contains 231 cu. in.

A cubic foot of water contains 7½ gallons, 1728 cubic inches, and weighs 62½ lbs.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434.

Steam rising from water at its boiling point (212 degrees) has a pressure equal to the atmosphere (14.7 lbs. to the square inch).

A standard horse power: The evaporation of 30 lbs. of water per hour from a feed water temperature of 100° F. into steam at 70 lbs. gauge pressure.

To find capacity of tanks, any size; given dimensions of a cylinder in inches, to find its capacity in U. S. gallons: Square the diameter, multiply by the length and by .0034.

To ascertain heating surface in tubular boilers multiply ⅔ the circumference of boiler by length of boiler in inches, and add to it the area of all the tubes.

One-sixth of tensile strength of plate multiplied by thickness of plate and divided by one-half the diameter of boiler gives safe working pressure for tubular boilers. For marine boilers add 20 per cent for drilled holes.

To find the capacity of an air compressor in cubic feet of free air per minute: Multiply the area of low pressure cylinder (on compound compressor), or area of simple compressor cylinder in square inches, by the stroke in inches, and divide by 1728; and multiply this result—

(a) In single acting, simple or compound, by the R. P. M.
(b) Double acting, simple or compound, by 2 X the R. P. M.
(c) Duplex double acting, by 4 X R. P. M.

Weights of Various Substances

Per cubic foot

Names of Substances.	Aver. Weight Pounds
Anthracite, solid, of Pennsylvania	93
Anthracite, broken, loose	54
Anthracite, broken, moderately shaken	58
Anthracite, heaped bushel, loose	(80)
Ash, American white, dry	38
Asphaltum	87
Brass, (Copper and Zinc), cast	504
Brass, rolled	524
Brick, best pressed	150
Brick, common hard	125
Brick, soft, inferior	100
Brickwork, pressed brick	140
Brickwork, ordinary	112
Cement, hydraulic, ground, loose, American Rosendale	56
Cement, hydraulic, ground, loose, American, Louisville	50
Cement, hydraulic, ground, loose, English, Portland	90
Cherry, dry	42
Chestnut, dry	41
Coal, bituminous, solid	84
Coal, bituminous, broken, loose	49
Coal, bituminous, heaped bushel, loose	(74)
Coke, loose, of good coal	27
Coke, loose, heaped bushel	(38)
Copper, cast	542
Copper, rolled	548
Earth, common loam, dry, loose	76
Earth, common loam, dry, moderately rammed	95
Earth, as a soft flowing mud	108
Ebony, dry	76
Elm, dry	35
Flint	162
Glass, common window	157
Gneiss, common	168
Gold, cast, pure, or 24 carat	1204
Gold, pure hammered	1217
Granite	170
Gravel, about the same as sand, which see	
Hemlock, dry	25
Hickory, dry	53
Hornblende, black	203
Ice	58.7
Iron, cast	450
Iron, wrought, purest	485
Iron, wrought, average	480
Ivory	114
Lead	711
Lignum Vitae, dry	83
Lime, quick, ground, loose, or in small lumps	53
Lime, quick, ground, loose, thoroughly shaken	75

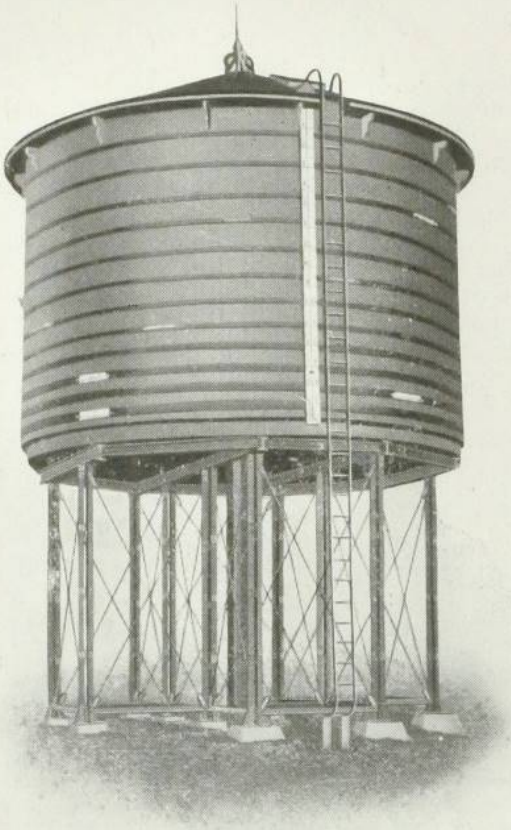
Weights of Various Substances—Continued

Per cubic foot

Names of Substances.	Aver. Weight Pounds
Lime, quick, ground, loose, per struck bushel	(66)
Limestones and Marbles	168
Limestones and Marbles, loose, in irregular fragments	96
Mahogany, Spanish, dry	53
Mahogany, Honduras, dry	35
Maple, dry	49
Marbles, see Limestones.	
Masonry, of granite or limestone, well dressed	165
Masonry, of mortar rubble	154
Masonry, of dry rubble (well scabbled)	138
Masonry, of sandstone, well dressed	144
Mercury, at 32° Fahrenheit	849
Mica	183
Mortar, hardened	103
Mud, dry, close	80 to 110
Mud, wet, fluid. maximum	120
Oak, live, dry	59
Oak, white, dry	52
Oak, other kinds	32 to 45
Petroleum	55
Pine, white, dry	25
Pine, yellow, Northern	34
Pine, yellow, Southern	45
Platinum	1342
Quartz, common, pure	165
Rosin	69
Salt, coarse, Syracuse, New York	45
Salt, Liverpool, fine, for table use	49
Sand, of pure quartz, dry, loose	99 to 106
Sand, well shaken	99 to 117
Sand, perfectly wet	120 to 140
Sandstones, fit for building	151
Shales, red or black	162
Silver	655
Slate	175
Snow, freshly fallen	5 to 12
Snow, moistened and compacted by rain	15 to 50
Spruce, dry	25
Steel	490
Sulphur	125
Sycamore, dry	37
Tar	62
Tin, cast	459
Turf or Peat, dry, unpressed	20 to 30
Walnut, black, dry	38
Water, pure rain or distilled, at 60° Fahrenheit	62⅓
Water, sea	64
Wax, bees	60.5
Zinc or Spelter	437

Green timbers usually weigh from one-fifth to one-half more than dry.

Wooden Tank on Steel Tower



50,000 gallon Water Tank on laced angle steel substructure.

Tanks and towers furnished to meet any requirement. We also erect tanks on either steel or wood substructures and install complete water stations, including gasoline or steam pumping outfits.

We furnish and erect wood tanks and steel towers of any height for manufacturing plants and for fire protection, complying with requirements of insurance companies.

We manufacture Tank Discharge Fixtures and Water Columns of approved designs.

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