



TRAINLOAD LIMITED

CAR PULLERS

**HIGH SPEED
AUTOMATIC
RAIL LOADING**

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TRAINLOAD LIMITED

The company was formed in 1963 as a result of a commission to design and construct an automatic terminal for loading of the first "liner trains to be used in the UK. The Liner train concept was introduced in that year by British Rail with the idea of speeding up and lowering the cost of the transport of bulk freight, particularly oil, chemicals and coal. Since that early start we have been privileged to provide such facilities for most major UK industries and we are one of the main suppliers of such equipment in the UK.

This handbook is divided into two sections covering the systems supplied by the company.

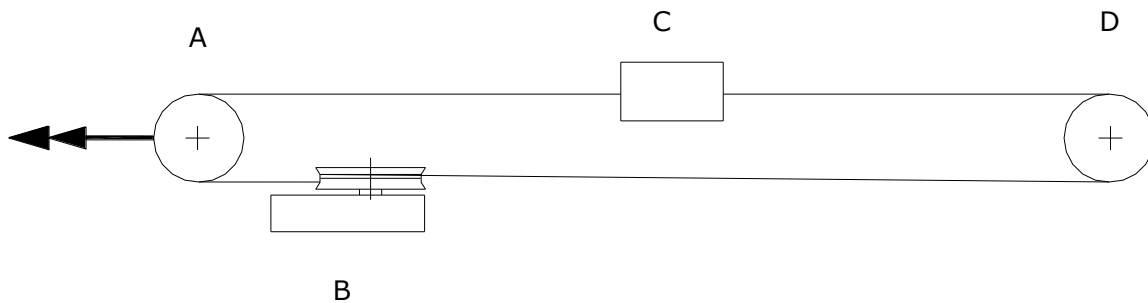
CAR PULLERS (TRAIN HAULAGES)

Car pullers tends to be the American term and is also used in many overseas countries. Haulages is the term generally used by the mining industry and tends to be more common in the UK

Both terms refer to lineside equipment, which moves trains along a given section of track, usually by means of a wire rope system. All our systems have full remote control so that the operator may be placed in the most advantageous position or they can be controlled by a computer from a main control station, linked to other operations. Car Pullers can be supplied for trains upto 2,000 tonnes.

UNILOKOMOTIVE ROAD/RAIL SHUNTERS

Trainload are agents for the Unilok range of Road/Rail Shunting Vehicles, which can either compliment the Trainload systems or can be used as an alternative, where conditions are more suited to this type of application.



Reduced to essentials the system comprises an endless wire rope passing around two terminal pulleys A & D, with the two ends fastened to a device C, which attaches to the train.

The rope is driven by winch B by means of three laps around a smooth surge wheel.

Device C can be either a trolley which passes under the train on its own auxiliary track and attaches to a pair of running wheels, or a buffer wagon which runs on the main rails and attaches to "the coupling gear of the end wagon.

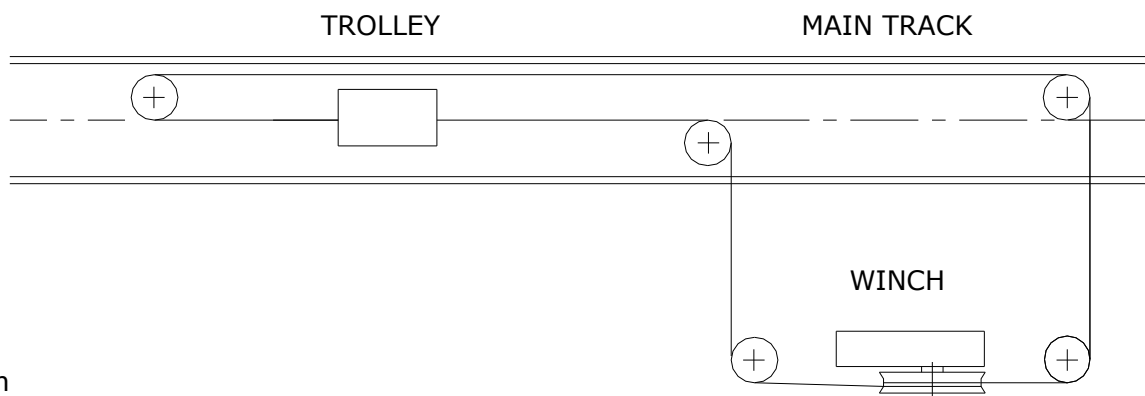
As most trains are moved by this method for either loading or unloading purposes, stopping accuracy is of importance. For this reason we employ a pre-tensioned rope system by means of jacks attached to pulley A. This ensured that the trailing rope in either direction of travel is always tensioned, avoiding the excessive run-on which is experienced with other systems.

The jacking system at pulley A also incorporates either spring or hydraulic dampers which ensure smooth non-slip operation on the surge wheel, and contribute to rope life by eliminating shock loads.

BASIC LAYOUTS

There are three basic layouts:

1. WINCH BESIDE TRACK



Application

- For through traffic, when trains are delivered on side of the loading installation, and collected on the other.
- Where wagons are to be separated and loaded individually or in small groups due to very hazardous conditions.
- When trains are to be split up or reassembled.

Restriction

- Trolleys cannot pass over turnouts. Where these are unavoidable, a buffer wagon system or rail spur layout must be used.
- Where it is necessary for a locomotive to pass over the equipment, the trolley is parked in a lowered 'ambush pit'.

2. WINCH BESIDE BUFFERS (SEE FIG. A)

Application: For layouts with buffer-ended track this is the preferred system as three pulleys and the auxiliary track are saved. This is a very robust layout and with less pulleys leads to a longer wire rope life.

At rest the buffer wagon stops against the buffer stop and acts as an extension to it. Thus the basic function of the buffer stop is retained. This system can also be used with central 'knuckle' type couplings and bumping posts.

3. BUFFER WAGON ON SPUR LINE (SEE FIG. B)

The buffer wagon remains at rest on its purpose built spur line until the train arrives. The wire ropes which lie in slots cut in the closure rail lift out as the buffer wagon passes over and settle in again when it has passed.

Application:

1. For through tracks where the weight of the loaded train is too great for the trolley system.
2. For the through tracks where other turnouts are present.

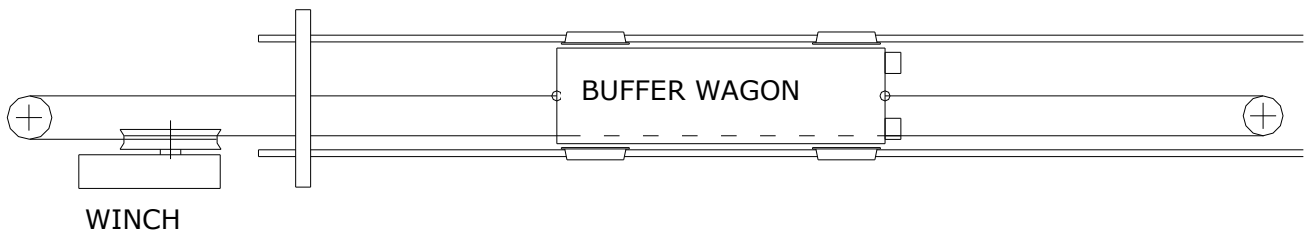
Note: We have standard drawings of slotted closure rails for all UK turnouts in common use for issue to the client's turnout manufacturer. For others, and for overseas customers, they can be prepared upon request.

VARIATIONS ON BASIC LAYOUTS

1. Winches grouped together in available area outside sidings, see fig. C
2. Winches on common base between tracks, see Fig. D
3. Winch situated below elevated trackwork, see Fig. E
4. Winch set at a distance from a hazardous area enabling industrial motor, brake and controls to be employed. See Fig. F
5. Curved track: All Trainload systems can be installed on curved track by means of deflector pulleys set at intervals along the operational length. In practise we try to avoid this as it leads to greater rope wear and higher installation costs. We can usually advise on how to avoid or minimise this if we are consulted in time.

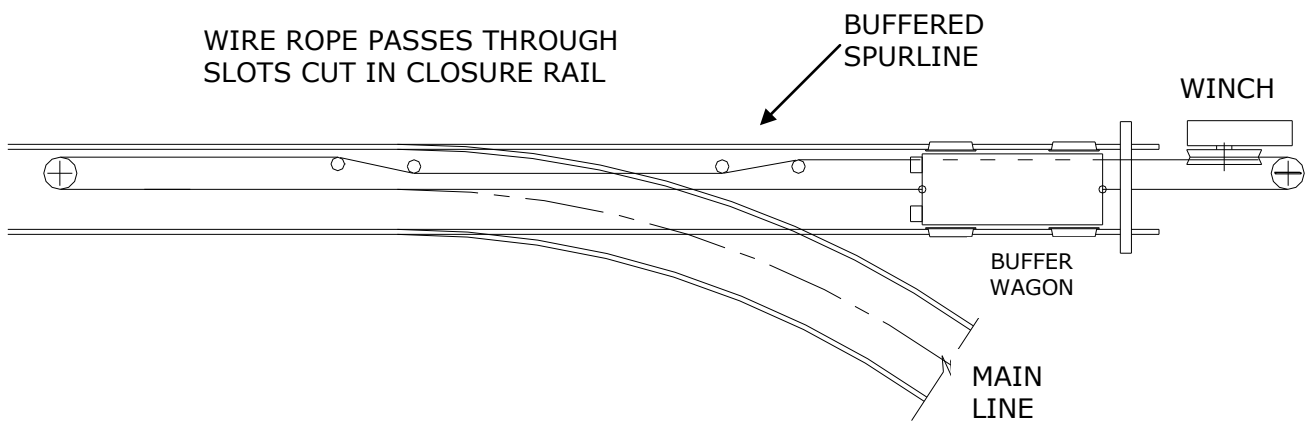
WINCH BEHIND BUFFERS WITH BUFFER WAGON

Fig.A



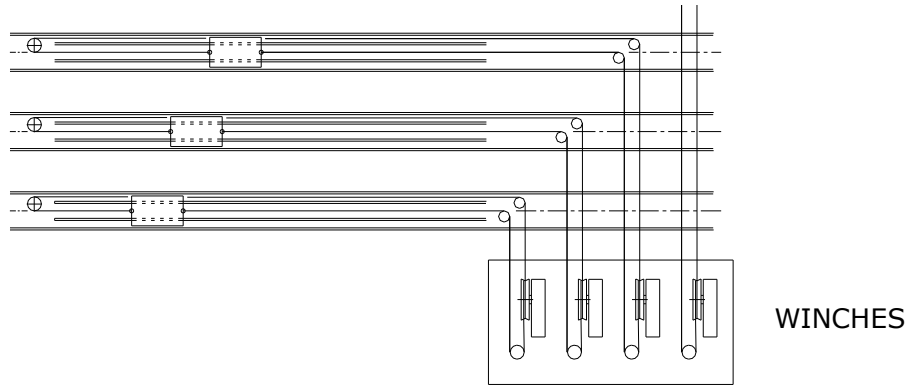
WINCH BEHIND BUFFERS ON SPUR LINE WITH BUFFER WAGON

Fig.B



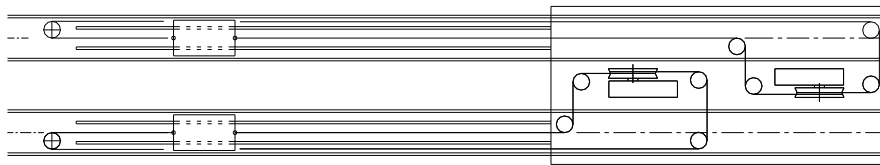
WINCHES GROUPED TOGETHER IN AVAILABLE AREA OUTSIDE SIDINGS WITH TRAINLOAD TROLLEY

Fig.C



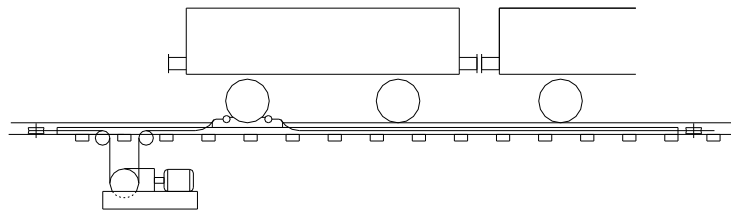
WINCHES ON COMMON BASE BETWEEN TRACKS

Fig.D



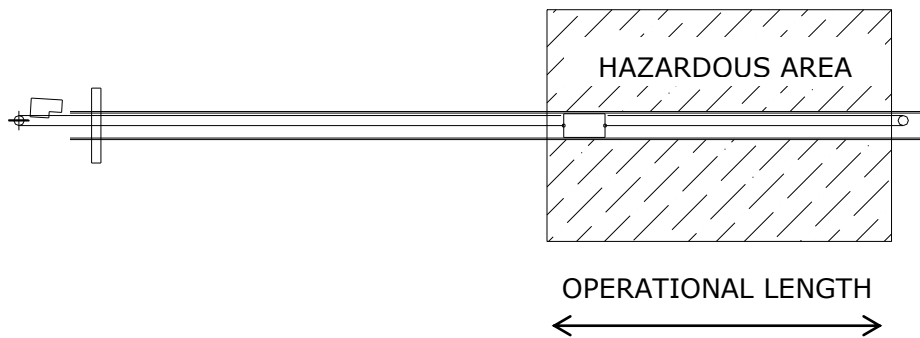
WINCHES SITUATED BELOW ELEVATED TRACKWORK

Fig.E



WINCH SET AT A DISTANCE FROM HAZARDOUS AREA

Fig.F



The 'Trainload' Trolley

This runs on its own auxiliary rails between the main rails.

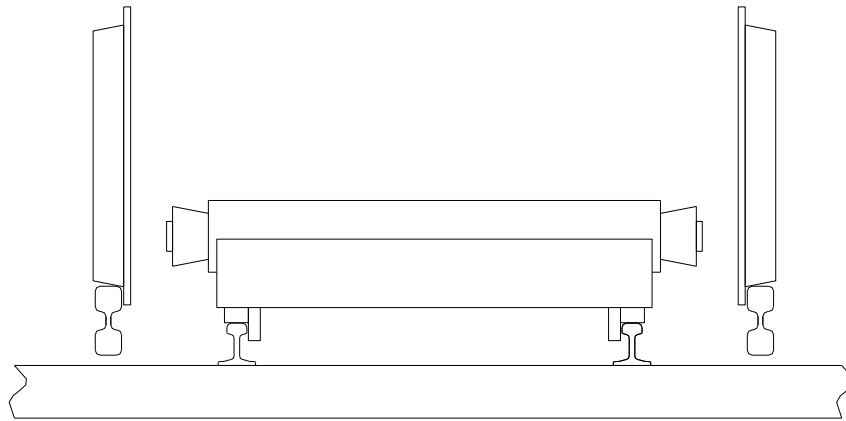


Fig. 1 – ARMS RETRACTED FOR PASSING UNDER TRAIN

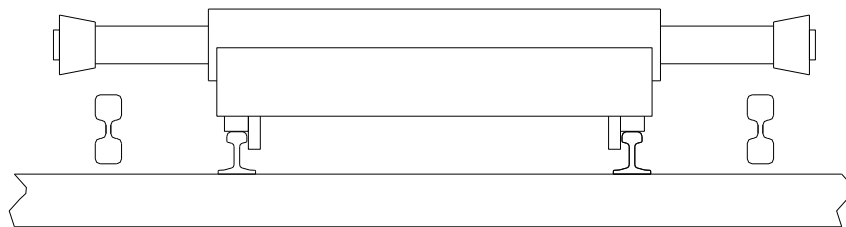


Fig. 2 – ARMS EXTENDED FOR MOVING TRAIN

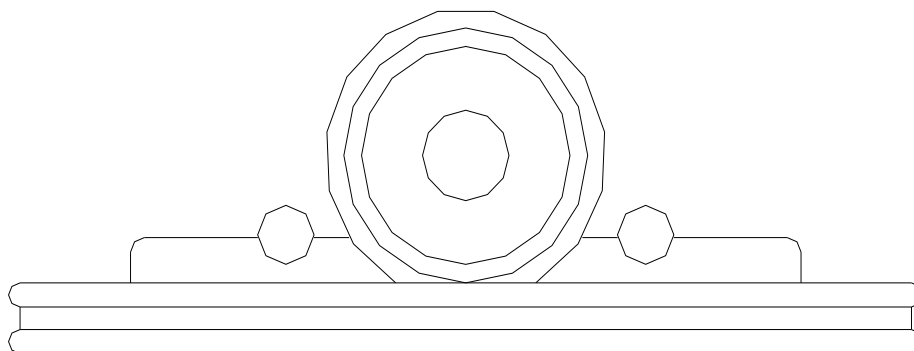
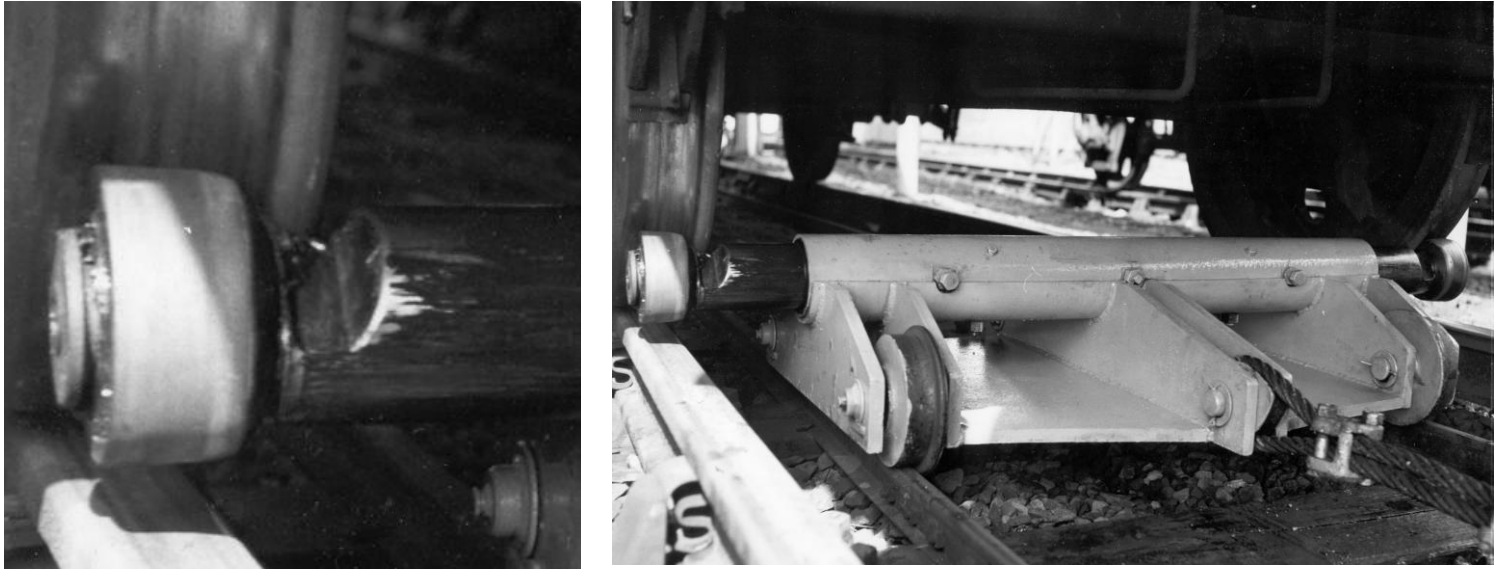


Fig. 3 – SIDE VIEW OF TROLLEY ENGAGED WITH CAR RUNNING WHEEL

Trolley in Contact with Car Wheels

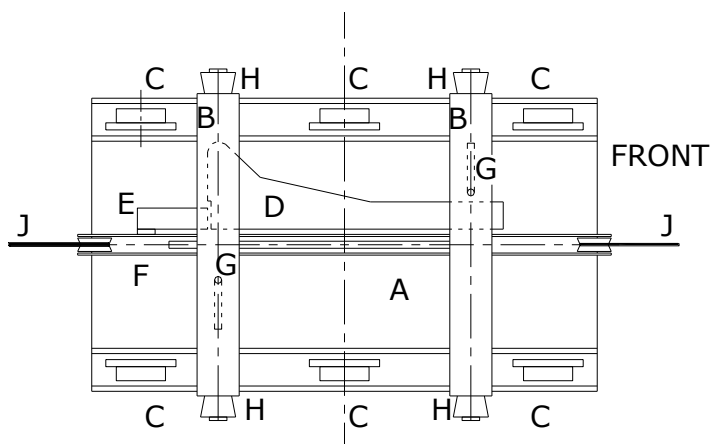


It can be seen that the contactor wheels are in contact across the treads of the running wheels. No contact is made with the flanges. This allows substantial forces to be transmitted to the running wheels without damage.

It should be noted that the vertical component of the hauling force is transmitted via the substantial pistons through the body of the trolley to the auxiliary rails. The contactor wheels do not come into contact with the main rails.

TROLLEY DETAILS

In plan view, with the covers off, the arrangement of the trolley is: ~

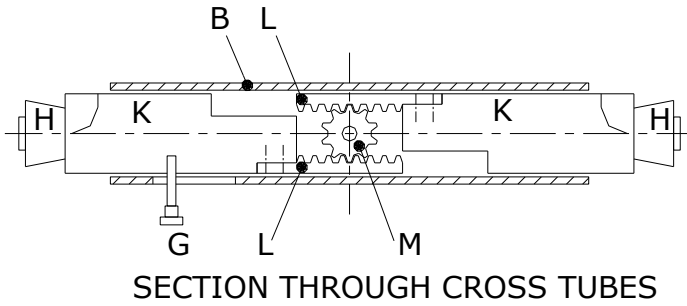


- A = Bedframe
- B = Cross tube
- C = Running wheels
- D = Radial arm
- E = Balance arm
- F = Sliding bars
- G = Actuating spindle
- H = Contactor wheel
- J = Wire rope

FIG 4

Basically it is a robust, fabricated mild steel carriage running on 6 wheels and carrying 2 cross tubes.

The cross tubes look like this in section:



- B = Piston tube
- G = Actuating spindle
- K = Piston arm
- L = Racks
- M = Pinion
- H = Contactor wheel

SECTION THROUGH CROSS TUBES

Fig 5

Each cross tube consists of a smooth bored tube with two opposed pistons, each piston having a toothed rack fixed to it. The racks engage on a central pinion such that the pistons must move in and out simultaneously. One cross tube has an actuating spindle 'G' fixed to a piston and working through a slot in the tube, which engages on an actuator fixed to the sleepers.

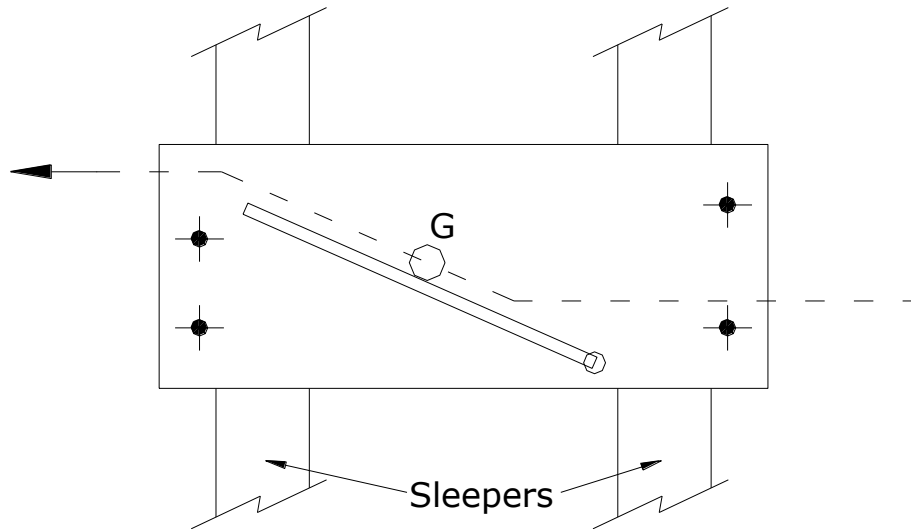


Fig.6

These can be arranged for extending or retracting the pistons.

The second cross tube has a similar actuating spindle 'G' fixed to its opposite side piston, also working on track actuators. Thus it can be seen that track actuators fixed on one side of the track centre line actuate one cross tube, and those fixed on the other side of the centre line actuate the second cross tube. From this it can also be seen that manual operation for extending/retracting can be carried out from either side of the track on both cross tubes.

The ends of the pistons are fitted with contactor wheels which bear on, and are profiled to the treads of the wagon running wheels.

Automatic Operation of Trolley

The wire rope is attached to two parallel sliding bars which can move relative to the trolley base. A balance arm attached to the sliding bars pushes on the radial arm, the ensuing rotatory movement of which extends the front cross tube pistons.

The following operating sequence now takes place:

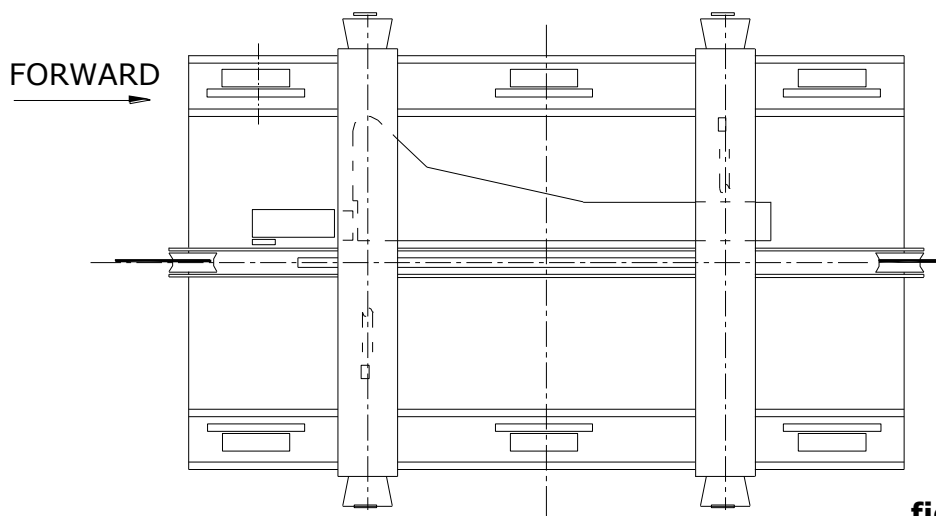


fig. 7

- 1 - Trolley is at rest in the start position with both cross tubes retracted and the radial arm in the 'closed' position.

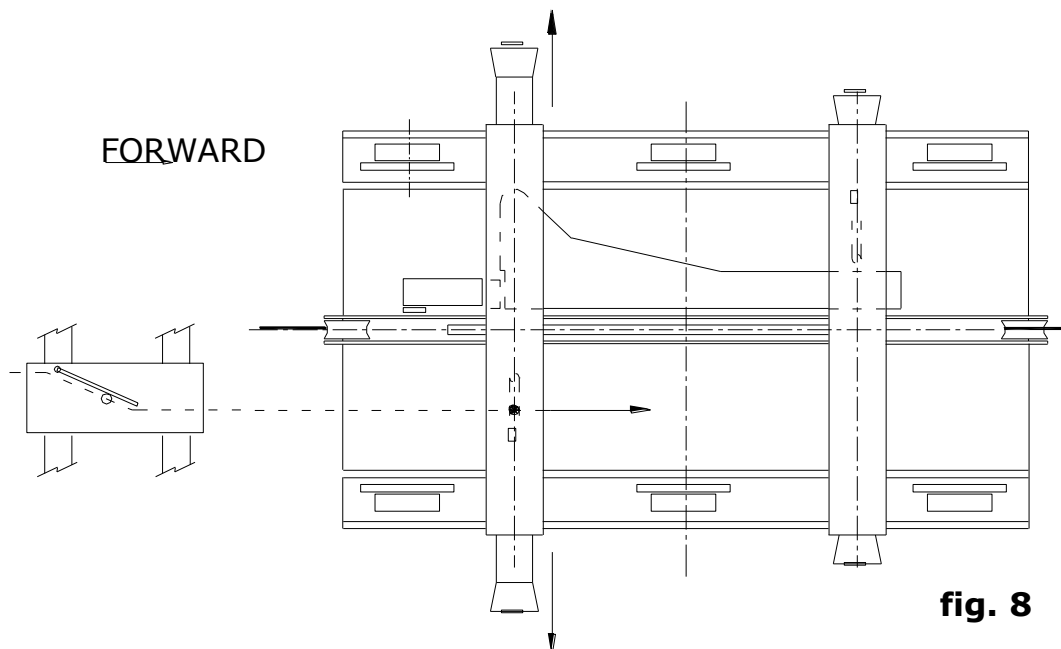


fig. 8

- 2 - Operator presses 'forward' button and the trolley moves off and over the first track actuator which extends the rear pistons.

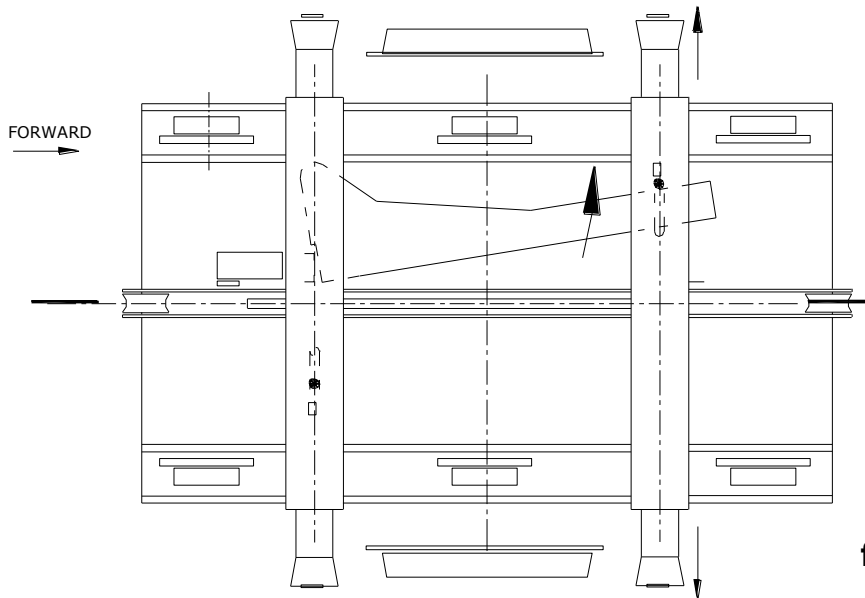


fig. 9

- 3 - Trolley continues to travel until extended rear arms contact the first pair of train wheels. This contact brings the trolley momentarily to a halt but the wire & sliding bars continue to move ahead with the attached balance arm causing the radial arm to partially rotate and bring out the front pistons. The train then starts to move, fully restrained in either direction, under the complete control of the operator. It can now be stopped and moved in either direction by the remote controls.
- 4 - Loading/Unloading now takes place under the control of the operator. On completion of the Loading/Unloading, the operator has only to once more press the 'forward' button and the following sequence automatically takes place:

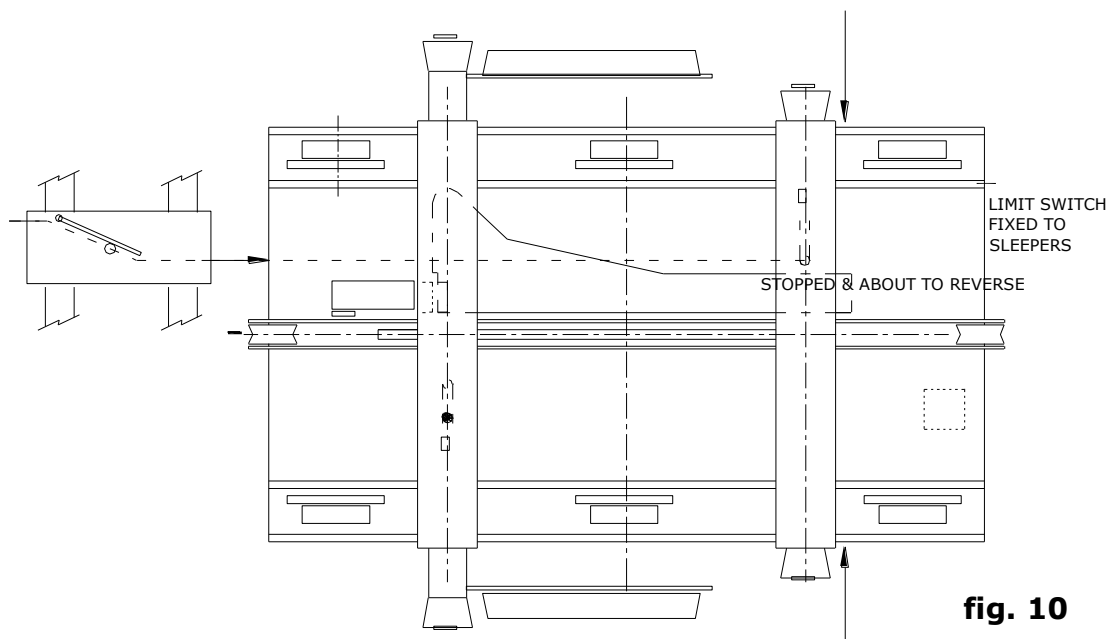


fig. 10

- 5 - The trolley passes over a track actuator which retracts the front arms. At the same time, a track limit switch stops the trolley and immediately reverses it.

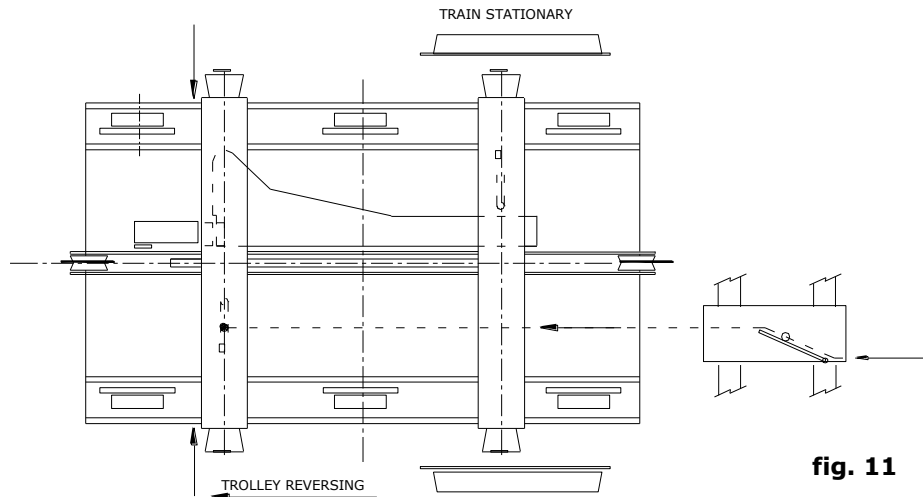


fig. 11

6 - Immediately on reversing, the trolley passes over another track actuator which retracts the rear arms. The trolley is now completely detached. In practice, the track actuators and limit switch mentioned in paras. 5 and 6 are set very closely together so that the train detachment takes place in a matter of seconds.

The trolley continues in the reverse direction until it stops in the original 'start' position, and is now ready for the next cycle.

SPECIAL TROLLEYS

The standard trolley has been developed for the UK application but is also suitable for many overseas countries. With minor alterations it can be made to conform to the standards of those countries which differ from the UK. It is available also for broad and narrow gauge railways, and indeed for any gauge should we be so instructed.

Some of the 'specials' we have developed over the years are:

1. A trolley for handling ladle and torpedo cars in steelworks capable of transmitting a horizontal force of 30 tonnes.
2. A 'flattened' version for use on combined road/rail loading systems where the auxiliary and main rails are set at the same level in the roadway.
3. A 'notched' version to accommodate cars with central disc brakes
4. A completely new design for use with UK 'freight liner' cars whose under body configuration is significantly different from other rolling stock.

The Trainload Buffer Wagon (or Dummy Wagon)

This can be employed only on buffer ended track, or with a spur siding layout as shown on page 4.

This is basically a solid block of concrete (or other ballast) in a steel frame on 4 running wheels which travels on the main rails, and is connected to the wire rope instead of the trolley.

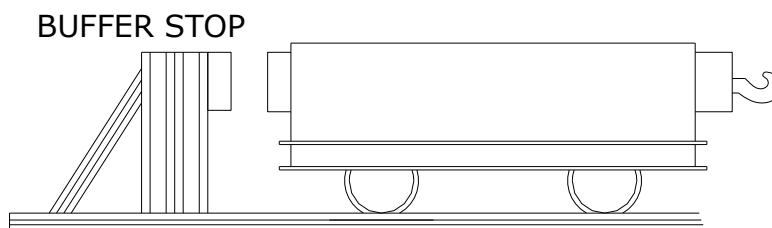


Fig. 13

In its simplest form as above it is fitted with an ordinary draw hook. This is coupled manually to the train by means of the coupling link on the end wagon. The operator then controls the movement of the train in either direction in the usual way.

Buffer wagons can also be fitted with 'Trainload' automatic couplings which attach and detach automatically from the train. (Fig.14)

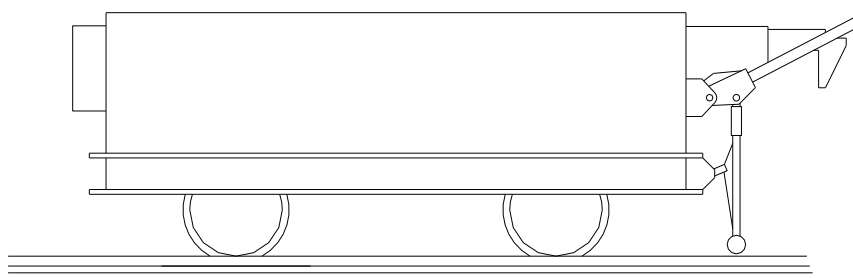
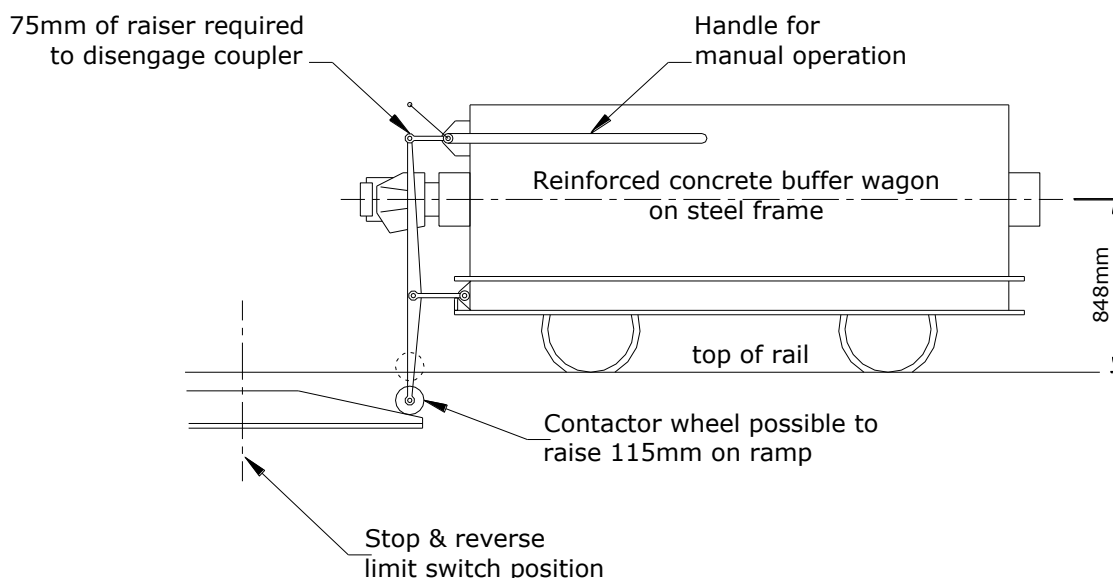


Fig. 14

For centrally mounted knuckle type coupling/buffers which engage automatically, Trainload have an arrangement, shown below which automatically detaches the coupling on completion of loading.



ADDITIONAL INFORMATION

WEIGHBRIDGES

It is essential when combining weighing and car pulling that the equipment is compatible. On some weighing systems the pulling trolley is weighed together with its attached wagon, leading to additional calculations. In many places, when weighing taxed products, this is just not allowed.

Due to its unique design, the Trainload trolley which carries its own weight and the downward component of the hauling force on the auxiliary rails, escapes this drawback provided there is a 'dead', area between the rails of the weighbridge.

One weighing system with which Trainload is fully compatible is FLINTAB UK. We have collaborated with Flintab on many installations, all successfully. With a TRAINLOAD/FLINTAB combined system the weighing figures are not affected in any way by the car puller.

OPTIONAL EQUIPMENT

We offer a safety tripwire system along one or both sides of the operational track work which completely stops the car pulling system. It is so arranged that the system can only be restarted by the operator resetting manual controls on that section of the track where the tripwire has been activated.

We also offer a rope movement sensor. This stops the winch after a predetermined time lag after the rope has stopped moving. This avoids rope damage if say the brakes have been left on the train, or if the train meets an obstruction.

STANDARDS

All UK equipment is designed and built to conform to the British Railways Board's code of Practice CP-PM-2. This is mandatory in the UK. Similarly in other countries we conform to their codes. In countries with no published Codes we still adhere to the British CP-PM-2, as being of a good general standard.

TRAINLOAD HAULAGE SYSTEMS

TYPICAL SPECIFICATION

30 HP – BUFFER WAGON SYSTEM

BUFFER WAGON

The buffer wagon will have a chassis cradle of welded mild steel construction running on four cast steel flanged wheels, each wheel running on a roller bearing and all fitted to a solid shaft.

The weight is maintained by pouring concrete into the chassis. Bolts are cast into the concrete to secure the buffing timbers and coupler.



TYPICAL SPECIFICATION

HAULAGE WINCH

The endless rope will be driven by a single winch unit. The winch will be driven by a T.E.F.C. 30 HP Motor.

SCHEDULE OF SIZES

Diameter of Surge Wheel	36" (914)
Width of Surge Wheel	6" (150)
Diameter of Surge Wheel Shaft	8" (200)
Surge Wheel Shaft Bearing	Two - 6" dia. X 10" long. (150x254)

GEARING

First Reduction	Worm Gear Unit
Second Reduction	Straight Spur

MOTOR

Horsepower of Motor	30 HP (22kW)
Speed of Motor	960 R.P.M.
Surge Wheel Speed	3.18 R.P.M.
Rope Speed	30 Feet per Minute (10 metres/Min)

SURGE WHEEL

Of solid cast iron core having its own boss bored and keywayed to suit the surge wheel shaft. To be fitted with replaceable hardened Cast Iron Trods.

SURGE WHEEL SHAFT

Would be of Mild Steel, machined all over, keywayed and journals polished.

GEAR BOX EXTENSION SHAFT

Would be an extension from the gear unit with a roller bearing on the outer end.

BEARINGS

The two surge wheel shaft bearings would be of heavy cast iron grease lubrication type. Each bearing would be of phosphor bronze, fitted onto bored and faced bodies and loose caps.

COUPLING

A centrifugal free shoe clutch will be fitted between the motor and the input shaft of the gearbox.

BRAKE

An Electro magnetic brake will be fitted to the outer rim of the coupling.

GUARDS

A guard would be supplied to cover the surge wheel, spur wheel, coupling and all rotating shafts.

BEDPLATES

Main members and intermediate members would be rolled steel sections with machined facing to take motor, gear units, bearings etc.

TESTS

The haulage would be run light with a works motor.

PAINTING - WINCH

The haulage would be painted with two coats of good quality paint (yellow) and bright parts treated with an anti-rust compound.

PULLEYS

The sheaves will be high-grade cast iron machined in the rope grooves and on the bosses, mounted in substantial welded mild steel frames. Mild steel shafts will be run in phosphor bronze bushes. Greasing points are provided.

HAULAGE ROPE

The haulage rope will be 6 x 19 (9/9/1) with I.W.R.C., with R.H. Langs lay. The diameter will be 24mm, the steel of 115 tons tensile and be pre-formed with a breaking load of 37 tons. The eyes are formed by using patent rope clips around solid thimbles.

HOLDING DOWN BOLTS

All the necessary high tensile fixing bolts for the tensioning gear, pulleys etc, will be supplied by us. Foundation bolts for the winch to be supplied by the civil contractor.

PAINTING - OTHER

All parts would be painted to our standard practice.

The Buffer Wagon would be finished in gloss yellow and all other steelwork would be given two coats of grey oxide. All bright parts would be suitably protected with an anti-rust preventative.

CONTROL GEAR

It would be a floor mounted weatherproof steel case with hinged front door to IP55 and cable entry would be through the bottom, onto an undrilled gland plate. It would consist of the following;

- a) All necessary forward and reverse contactors and relays.
- b) Transformer.
- c) Isolator interlocked with front door and suitable for locking in the off position.
- d) Brake contactor and relay.
- e) Fuses.
- f) Self contained push buttons for forward/reverse/stop.
- g) Terminals for limit switches and remote controls.
- h) All necessary identification labels.
- i) Local/Remote selector switch

LIMIT SWITCHES

Proximity limit switches would be provided at each end of the operational length to stop the haulage.

REMOTE CONTROL UNIT

Would be a wall mounted weatherproof steel case with hinged door to IP 55, cable entry through the bottom.

It would consist of the following;

- a) Forward/reverse push buttons.
- b) Stay put stop button.

TENSIONING DEVICES

The tensioning jacks at the end are used periodically to take up the natural stretch of the rope.

TRAINLOAD HAULAGE SYSTEMS

TYPICAL SPECIFICATION

30 HP – TROLLEY SYSTEM

HAULAGE TROLLEY

The trolley will be the standard 'Trainload' type with a chassis cradle of welded mild steel construction running on six flanged wheels, each wheel being of good cast iron and fitted with phosphor bronze bush and axle.

The wheel tread engaging mechanism is carried on the cradle and is a removable self-contained unit. The advantage of this is that in the event of damage occurring, or of maintenance purposes, the unit can be lifted off by two men and replaced with a spare in a matter of minutes, leaving the affected unit to be repaired/maintained properly in a workshop, and more important, interfering only minimally with the operation.

The wheel engaging mechanism comprises a length of mechanical tube, bored to close tolerances and containing two opposed pistons manufactured in EN 19 steel. Racks and pinion of hardened steel connect the pistons to each other. The pinion is mounted on a shaft with heavy duty sealed for life bearing in the centre line of the tube, such that both pistons move in and out together. At the extremity of each piston a contactor wheel is fitted. They run on roller bearing and the side thrust is opposed by a needle thrust bearing.



TYPICAL SPECIFICATION

HAULAGE WINCH

The endless rope will be driven by a single winch unit. The winch will be driven by a T.E.F.C. 30 HP Motor.

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Surge Wheel Speed	3.18 R.P.M.
Rope Speed	30 Feet per Minute (10 metres/Min)

SURGE WHEEL

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SURGE WHEEL SHAFT

Would be of Mild Steel, machined all over, keywayed and journals polished.

GEAR BOX EXTENSION SHAFT

Would be an extension from the gear unit with a roller bearing on the outer end.

BEARINGS

The two surge wheel shaft bearings would be of heavy cast iron grease lubrication type. Each bearing would be of phosphor bronze, fitted onto bored and faced bodies and loose caps.

COUPLING

A centrifugal free shoe clutch will be fitted between the motor and the input shaft of the gearbox.

BRAKE

An Electro magnetic brake will be fitted to the outer rim of the coupling.

GUARDS

A guard would be supplied to cover the surge wheel, spur wheel, coupling and all rotating shafts.

BEDPLATES

Main members and intermediate members would be rolled steel sections with machined facing to take motor, gear units, bearings etc.

TESTS

The haulage would be run light with a works motor.

PAINTING - WINCH

The haulage would be painted with two coats of good quality paint (yellow) and bright parts treated with an anti-rust compound.

PULLEYS

The sheaves will be high-grade cast iron machined in the rope grooves and on the bosses, mounted in substantial welded mild steel frames. Mild steel shafts will be run in phosphor bronze bushes. Greasing points are provided.

HAULAGE ROPE

The haulage rope will be 6 x 19 (9/9/1) with I.W.R.C., with R.H. Langs lay. The diameter will be 24mm, the steel of 115 tons tensile and be pre-formed with a breaking load of 37 tons. The eyes are formed by using patent rope clips around solid thimbles.

AUXILIARY TRACK

The auxiliary track should be of 20lb flat bottomed rail (or similar) fixed to sleepers by dog spikes

HOLDING DOWN BOLTS

All the necessary high tensile fixing bolts for the tensioning gear, pulleys etc, will be supplied by us. Foundation bolts for the winch to be supplied by the civil contractor.

PAINTING - OTHER

All parts would be painted to our standard practice.

The Trolley would be finished in gloss yellow and all other steelwork would be given two coats of grey oxide. All bright parts would be suitably protected with an anti-rust preventative.

CONTROL GEAR

It would be a floor mounted weatherproof steel case with hinged front door to IP55 and cable entry would be through the bottom, onto an undrilled gland plate. It would consist of the following;

- j) All necessary forward and reverse contactors and relays.
- k) Transformer.
- l) Isolator interlocked with front door and suitable for locking in the off position.
- m) Brake contactor and relay.
- n) Fuses.
- o) Self contained push buttons for forward/reverse/stop.
- p) Terminals for limit switches and remote controls.
- q) All necessary identification labels.
- r) Local/Remote selector switch

LIMIT SWITCHES

Proximity limit switches would be provided at each end of the operational length to stop the haulage.

REMOTE CONTROL UNIT

Would be a wall mounted weatherproof steel case with hinged door to IP 55, cable entry through the bottom.

It would consist of the following;

- c) Forward/reverse push buttons.
- d) Stay put stop button.

TENSIONING DEVICES

The tensioning jacks at the end are used periodically to take up the natural stretch of the rope.

Some Features and Advantages of the Trainload Car Puller System

- ❖ A simple concrete slab foundation is all that is required at either end of the system. There are no pits, under track tunnels, etc., which entrap vapour. This leads to very low associated civil engineering costs.
- ❖ The pre tensioned wire system leads to a much greater stopping accuracy than with the more usual slack wire system.
- ❖ Extremely simple robust construction leading to great operational reliability and absence of downtime.
- ❖ Easy maintenance. The working parts which come into contact with the train are contained in detachable cross tubes. These can be removed from the trolleys by two men in a matter of minutes without lifting equipment and spare units dropped in as easily. The worn components of the tube can then be replaced or refurbished in the workshop without putting the track in question out of action.
- ❖ Complete manual override of the automatic engage/disengage mechanism of the trolley at any point in the operational length. This is done in a matter of seconds by one man and is useful if handling cars singly or in small groups. It is also a vital feature in an emergency in which the electrical control has been affected, allowing the immediate release of the train for evacuation by a locomotive.
- ❖ Simple and foolproof operation. The operator has no need to know where the trolley is or how it is positioned in relation to the train. He only has to press the forward-stop-reverse buttons to load the train and can concentrate on the business of obtaining the maximum throughput.
- ❖ The haulage rope is driven by a smooth drive wheel, a feature which is also an in-built safety factor. In the event that the locomotive either strikes or attempts to pull out a train which is still attached to the car puller (an event which in spite of all precautions happens with regularity), the rope slides around the drum instead of breaking.
- ❖ All Trainload Car Puller Systems installed since 1963 are still in use, and have many years service still to offer. Several have been re-located by us to different sites, but they still continue to work reliably. A service life in excess of 30 years can therefore be assured.

PRINCIPLES of TRACTION

In order to select the correct size of car puller it is necessary to consider the forces involved in moving a train:

STARTING RESISTANCE (S.R.)

ROLLING RESISTANCE (R.R.)

One of the main reasons for the existence of railways is that the force required to move a load is low. The force is generally expressed in kg/tons. It is very important to understand that this resistance varies depending on whether the train is starting or moving.

Starting Resistance

7.5kg/ton

Rolling Resistance

3kg/ton

We are assuming that the wagons are fitted with roller bearings, and regularly maintained.

For older wagons with Journal bearings, the values are slightly different on starting, but the same once in motion.

Starting Resistance

9.5kg/ton

Rolling Resistance

3 kg/ton

Wagons with old unlubricated journal bearings will have much higher resistances and the extreme case is when the axle refuses to turn at all in a wagon which has been put aside for many years.

Rolling resistance is given for low speed operation. The value does not depend on speed, as in shunting, speeds are normally about 0-10km/hr.

Taking a 500t train for example.

STARTING RESISTANCE (S.R.) = $500 \times 7.5 = 3750\text{kg}$

ROLLING RESISTANCE (R.R.) = $500 \times 3 = 1500\text{kg}$

i.e. the most difficult task that a shunter has is to start the train moving.

Once the train has started moving, it is easy to keep it moving.

All this supposes straight level track in good condition.

Curves and gradients have a significant effect on the job to be done, and can easily double or triple the resistance involved.

GRADIENT RESISTANCE (G.R.)

Gradient resistance is easily calculated, 1 kg/ton for each 1°/00 (per mm) of gradient but the gradients must be measured with corresponding accuracy.

1% gradient gives 10kg/ton resistance.

If we take a 500t train on a 4% gradient, the extra resistance for the gradient is:

$500 \times 4 = 2000\text{kgs.}$

To start the train on a gradient

STARTING RESISTANCE $7.5. \times 500 = 3750$

GRADIENT RESISTANCE $4 \times 500 = \underline{2000}$

TOTAL RESISTANCE $= 5750$

Note that the gradient resistance is constant, irrespective of the train starting or already rolling.

CURVATURE RESISTANCE (C.R.)

Curves also play an important role in determining total train resistance, and obviously the sharper the curve the higher the resistance.

Curvature resistance kg ton = $750/R$

R is radius of curvature in metres.

Curves are sometimes defined by degrees, but this is a definition which can be misleading, and the simplest method is to use the radius expressed in metres.

If radius is 150m

Curvature Resistance = $750/150 = 5\text{kg ton}$

Or for a 500t train:

$500 \times 5.0 = 2500\text{kg.}$

As with gradient resistance, curvature resistance does not vary whether the train is starting or moving.

NOTE: WIDENING OF GAUGE

Railway gauge must be widened on curves to allow the wheel flanges to pass easily. Standards can vary from country to country, but typical values would be as follows: -

<u>Radius of Curvature</u>	<u>Gauge</u>
Straight- 200m	1524mm
150m -200m	1530mm
100m -150	1536mm
100m	1542mm

If the gauge is not widened sufficiently on curves. then the wheel flanges tend to jam and the resistance increases enormously.

Finally. we can make a brief reference to measuring curvature.

The easiest practical method is to measure the height between a chord and the track. as is shown on the diagram TI.

Care must be taken when measuring as sharp curves are found on switches and turnouts. Also in freight yards it is common to have uneven curves. and several measurements may be necessary.

TRACK CONDITION

Track condition plays its role as well. but it is difficult to measure "bad" track conditions.

Allowances are made by the experienced observers. and values would range:

RESISTANCE FOR POOR TRACK (P.T.R.) 0- 4kg/ton

Table T2 shows combinations of all the above mentioned combinations.

MEASUREMENT OF CURVATURE

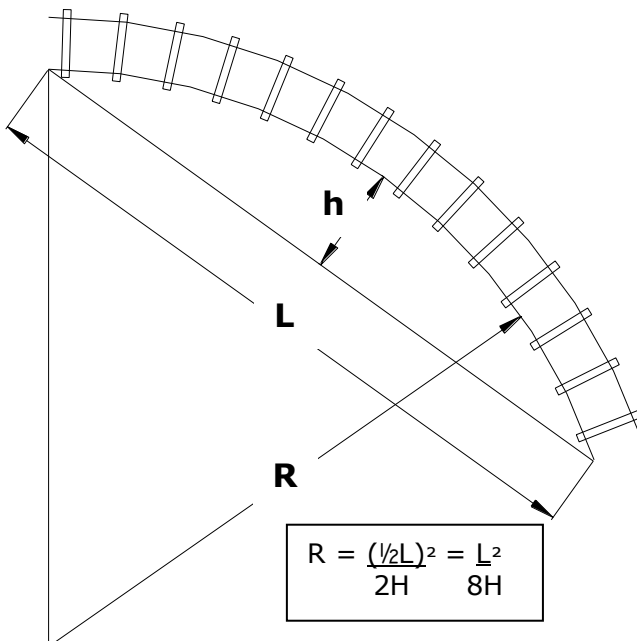


Table of values, L = 20m (standard length)

h (cm)	R (m)	Curvature resistance
10cm	500m	1.5 kg/ton
20cm	250m	3.0 kg/ton
30cm	167m	4.5 kg/ton
40cm	125m	6.0 kg/ton
50cm	100m	7.5 kg/ton
60cm	83m	9.0 kg/ton

Table T2

TABLE T2 TRAIN RESISTANCE AND RUNNING CONDITIONS

Combination Kg/t Resistance	Straight	Curve	Gradient	Fair Track	Curve + Gradient	Curve + Gradient + Fair Track
Rolling 3kg	3	3	3	3	3	3
Curve 750/150 = 5kg	-	5	-	-	5	5
Gradient 4kg	-	-	4	-	4	4
Fair Track 2kg	-	-	-	2	-	2
Total Resistance for 500t train <u>already rolling</u>	1500	4000	3500	2500	6000	7000kg
Total Extra Resistance to start train 4.5kg/ton	2250	2250	2250	2250	2250	2250
Total Resistance to <u>start</u> train	3750	6250	5750	4750	8250	9250

If the train has to be started on a straight gradient, 5750kg effort will be required.

If the train then must negotiate a curve and gradient, 6000kg effort will be required.
Theoretically, a 6000kg effort is sufficient.

However, should the train have to stop for any reason on the curved gradient, such an effort would be inadequate as 8250kg will be required to start it again.

CLIENTS

A selection of clients, for whom we have provided rail loading systems in recent years, the majority of whom have favoured us with several commissions.

BRITISH RAIL
ESSO PETROLEUM CO.LTD
TEXACO LTD
SIMON CARVES LTD
LINDSEY OIL REFINERY LTD
BRITISH STEEL PLC
CADBURY'S LTD
B.P. ITALIANA
ICI LIMITED
INEOS CHOR LIMITED
AS-C MATERIALS HANDLING LTD
PAKTANK LTD
SHELL UK LTD
FOSTER WHEELER LTD
NATIONAL COAL BOARD
CONOCO LTD
SHELL MEX & B.P LTD
BRITISH GAS CORPORATION
BRITISH NUCLEAR FUELS LTD
FLUOR (TRANSVAAL) LTD
FLUOR GMBH, HAMBURG
SASOL PTY, REPUBLIC OF SOUTH AFRICA
THE TURKISH STATE PETROLEUM CORPORATION
WEST'S ENGINEERING DESIGN LTD
EDINBURGH DISTRICT COUNCIL
HOESCH MASCHINEFABRIK DEUTCHLAND AG
TIOXIDE LIMITED
THE IMMINGHAM STORAGE CO. LTD
MOBIL OIL LTD
LONDON BRICK CO. LTD
BRITISH PETROLEUM LTD
DAVY ASHMORE INTERNATIONAL LTD
BECHTEL INTERNATIONAL LTD
C.J.B LTD/ICI LTD
TAR DISTILLERS LTD
CHEVRON OIL, BELGIUM
BRITISH PIPELINE AGENCY LTD
TARMAC LTD
PEDIGREE PETFOODS LTD
WELLMAN ENGINEERING CORPORATION
GULF OIL REFINERY LTD
SEAL SANDS STORAGE LTD
ROMANIAN STATE INSTITUTE OF REFINERY
SHELL (STANLOW) LTD
PHILLIPS IMPERIAL PETROLEUM LTD
SHELL (CANADA) LTD
PORTS AUTHORITY (PEOPLES REPUBLIC OF CHINA)
BRITISH ALCAN LTD
B.P. AVONMOUTH
BATEMAN DAVY ENG. /MOSSGAS (REPUBLIC OF SOUTH AFRICA)
B.P. CHEMICALS LTD
GASPOL S.A (POLAND)
TUPRAS KIRIKKALE RAFINERI (TURKEY)