



GOVERNMENT POLYTECHNIC JAIPUR

**LECTURE NOTE
OF
MINE MACHINERY-I**

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ROPE HAULAGE

Transportation in Mines by Rope Haulage Systems

It is the one of the most important considerations in the efficient of an underground mine is the transport or haulage system

→ The main method of transport are follows:

(1) Track-mounted Haulage

- | | |
|------------------------------|------------------------|
| (A) Rope haulage | (B) Locomotive Haulage |
| (a) Direct rope haulage | (a) Diesel locomotive |
| (b) Main and Tail R. haulage | (b) Electric Battery " |
| (c) Endless rope haulage | (c) Trolley wire " |
| (d) Gravity " | (d) Cable reel " |
| (e) Mono rail | (e) Compressed air " |
| | (f) Steam locomotive |

(2) Trackless Haulage

- (A) Conveyor System
- (a) Belt conveyor
 - (b) cable belt conveyor
 - (c) Chain conveyors
 - (i) Scrapers chain conveyors
 - (ii) Armoured chain conveyors
 - (iii) Grate end loader
 - (iv) mobile stage loader
 - (v) Pick back conveyor
 - (d) Shaker conveyors

- (B) SPIRAL CHUTES (Gravity transportation)
- (C) HYDRAULIC TRANSPORTATION
- (D) PNEUMATIC TRANSPORTATION
- (E) WHEEL MOUNTED EQUIPMENT
 - (1) Shuttle cars
 - (2) Load Haul dump
- (F) AERIAL ROPEWAY
 - (1) Monocable
 - (2) Bicable
- (G) ~~SCRE~~ SCRAPERS OR SLUSHERS

Rope Haulage -

→ The Rope haulage can be successfully applied as Main haulage or secondary or gathering haulage

(Gathering haulage - This arrangement is that which operate betⁿ the working faces and main loading point.

Main haulage - betⁿ winding shaft to Main loading point)

is both longwall and pillar method of working

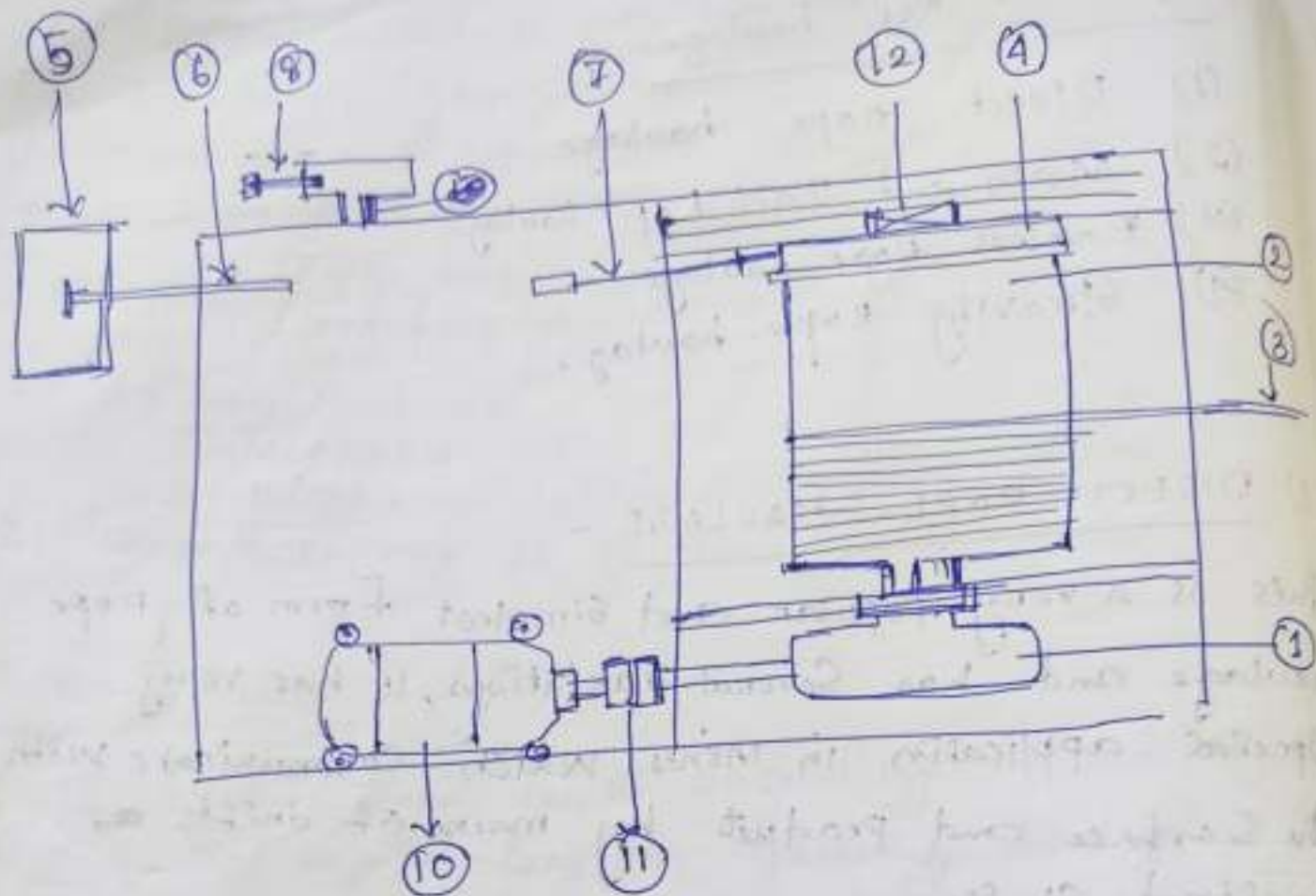
→ Rope haulage applicable to all existing installation and especially where the roadways are driven in a seam of varying gradients or in shallow mines where coal has to be hauled up an inclined drift to the surface

Type of Rope haulage

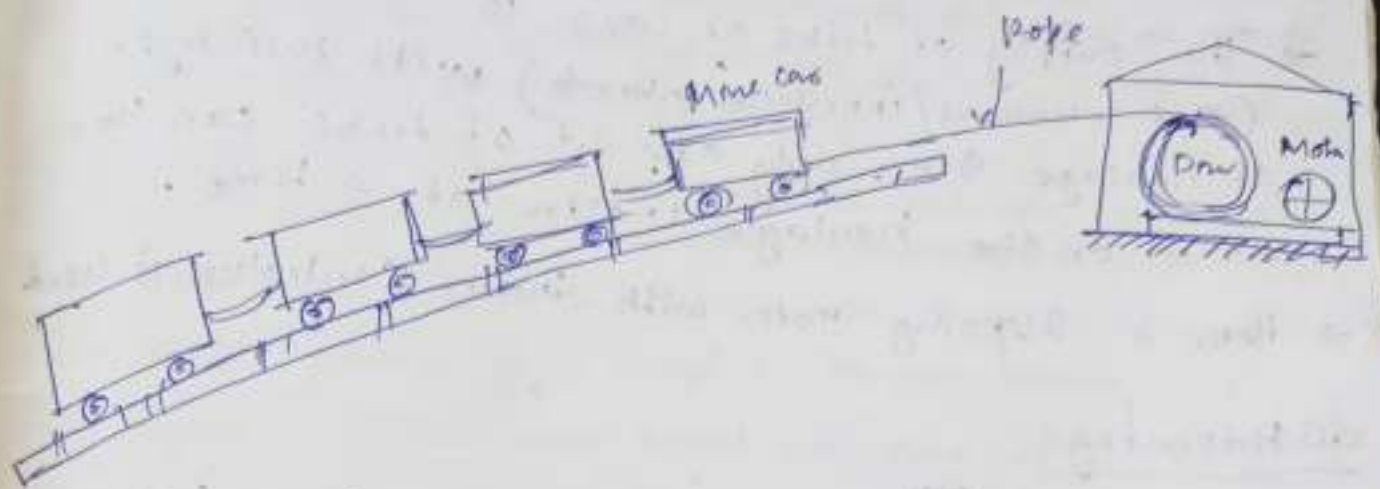
- (1) Direct rope haulage
- (2) Main and Tail Rope haulage
- (3) Endless rope haulage
- (4) Gravity rope haulage

(1) DIRECT ROPE HAULAGE -

- This is a very popular and simplest form of rope haulage and has several variations, it has very special application in mines which communicate with the surface and produce by means of drifts or inclined shafts.
- The equipment for this type of haulage consist of a single drum mounted on a shaft, a jaw clutch being used to disengage/Engage it from engine.
- power is supplied by a motor which drives the gears through the shafts.
- A length of rope is equal to the length of the haulage road.



- ① GEAR
- ② DRUM
- ③ ROPE
- ④ Brake path
- ⑤ Starter
- ⑥ controlled lever
- ⑦ Brake lever
- ⑧ Reversing and starting Switch handle
- ⑨ Liquid Controller
- ⑩ Motor
- ⑪ Flexible coupling
- ⑫ Bearing drum



- In this practice consists in having the haulage engine place at the top of the incline
- The ~~tops~~ tubs are attached to one end of the rope and the other end being fixed to the haulage drum.
- When empty tubs being lowered down the incline the speed is controlled by means of a brake pedal connected to a brake on drum
- In Some Many cases the empty tubs being lowered down gradient by their own weight and do not require power from the haulage engine, the drum shaft is therefore provided Reversing and Starting Switch handle
- The rope speed is generally 8-12 km/h and the system can operate between any point of the haulage plane and the haulage engine.

- When a full set of tubs has to be hauled down the incline, the clutch is disengage ^{so as to} and start the motor then the rotated drum. When motor rotates the shafts
- The supply of tubs or cars is intermittent (not continuous / irregular intervals) with this type of haulage since only one set of tubs can be run on the haulage incline at a time.
- Here a slipping motor with drum controller is used

Dis-Advantage

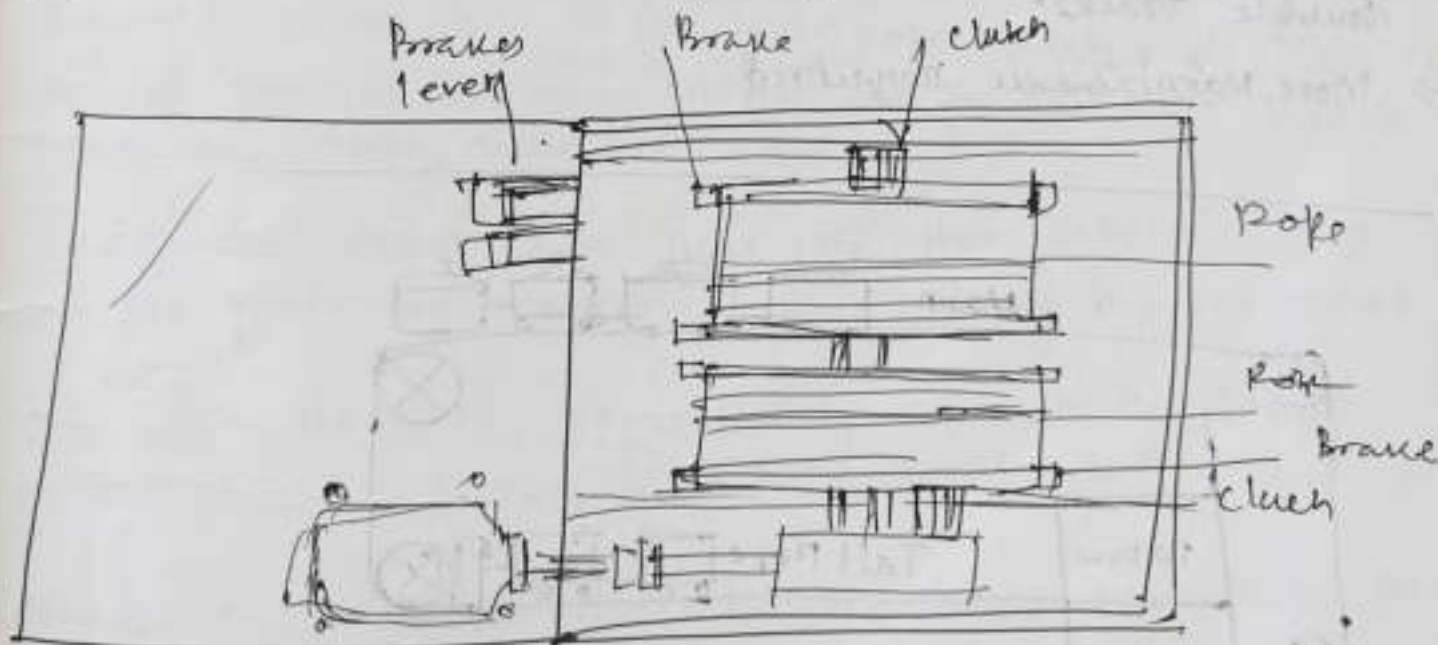
- ① ~~Require more~~ ^{Require more} braking duty on the downward run
- ② High peak power required as tubs starts its journey
- ③ High haulage speed demand
- ④ High standard of track maintenance required
- ⑤ Not suitable for mild inclination of roads.
- ⑥ A derailment is associated with heavy damage becoz the high speed

adv

- (1) Simple in operation
- (2) Extension easy
- (3) Can be used in narrow rope
- (4) Branch road can also served

DIRECT ROPE, Double drum balanced haulage - 19

- This is a modification of the direct haulage system.
- In this method, two drums are provided so that when a train of full tub is being hauled outbye, a set of empty tubs is lowered inbye.
- Both drums are fitted with clutches and are mounted on the same shaft; weight of the rope and tubs are balanced and
- The tubs are in 2 sets and a separate rope is attached to each set and wound in or out of its own drum.
- The motor is continuously rated and there are suspended or caliper type brakes - two to each drum.
- Each drum is separately clutched and when working the plane both drums are normally clutched.

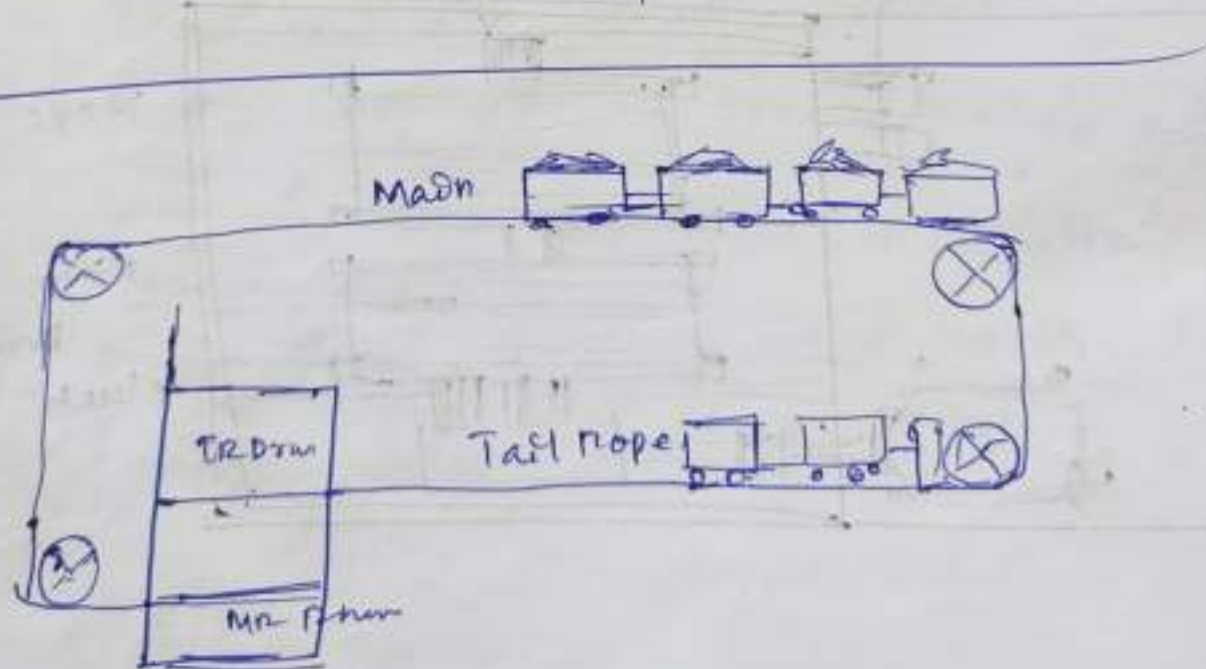


Advantages

- Avg power Required
- Peak horse-power is very much less.
- Fewer tubs are required per train, this results in ropes of smaller diameter, reduce drum diameter and reduce weight of cables.
- The delivery of tub is more regular
- High output capacity

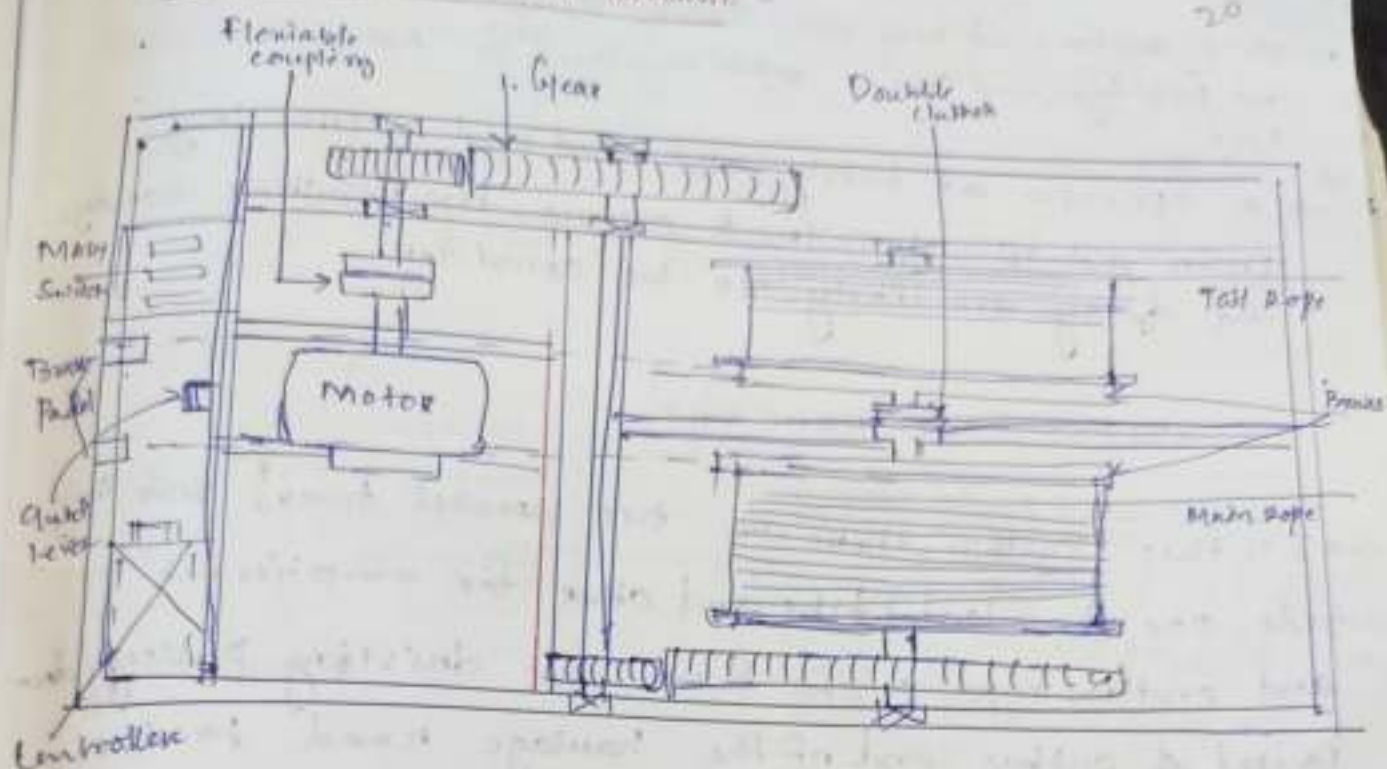
Dis-adv

- The haulage engine is larger and more expensive
- The system required wider roadway with double tracks.
- More maintenance required



MAIN AND TAIL ROPE HAULAGE -

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- In this system the hauling engine is provided with two separate drums, one is for Main rope which hauls the loaded ~~trucks~~ out and another for the Tail rope which hauls the empty train in.
- When one drum is in gear, the other revolves freely on the shaft but controlled, when necessary by the brake.
- The main rope is approximately equal to the length of the plane and Tail rope twice tail length.
- Brakes are attached fitted to each drum and drums are arranged so that each may be driven independently through clutches.
- This system can operate 12 to 18 km or even up to 20 km/h.

→ The system need only one track except in the landings and pass-ways and can be applied in narrow road.

→ It operates at fairly high speed and with long train and if derailment occurs, the resulting damage and delay are likely to be considerable.

→ ENDLESS ROPE HAULAGE →

→ In this system, there are two parallel tracks side by side, one for loaded tubs and other for empty tubs and endless rope passes from the driving pulley/drum located at outbye end of the haulage road to the inbye end and back again via a tension bogey return pulley.

→ The tubs, loaded as well as empty, are attached to the rope at regular intervals with the help of clips so that the entire rope length has tubs on tubs on is at intervals.

→ Only one tub is attached to the rope at a time with the help of different clips.

→ But where lashing chain is used for attachment, set of tubs is to attach.

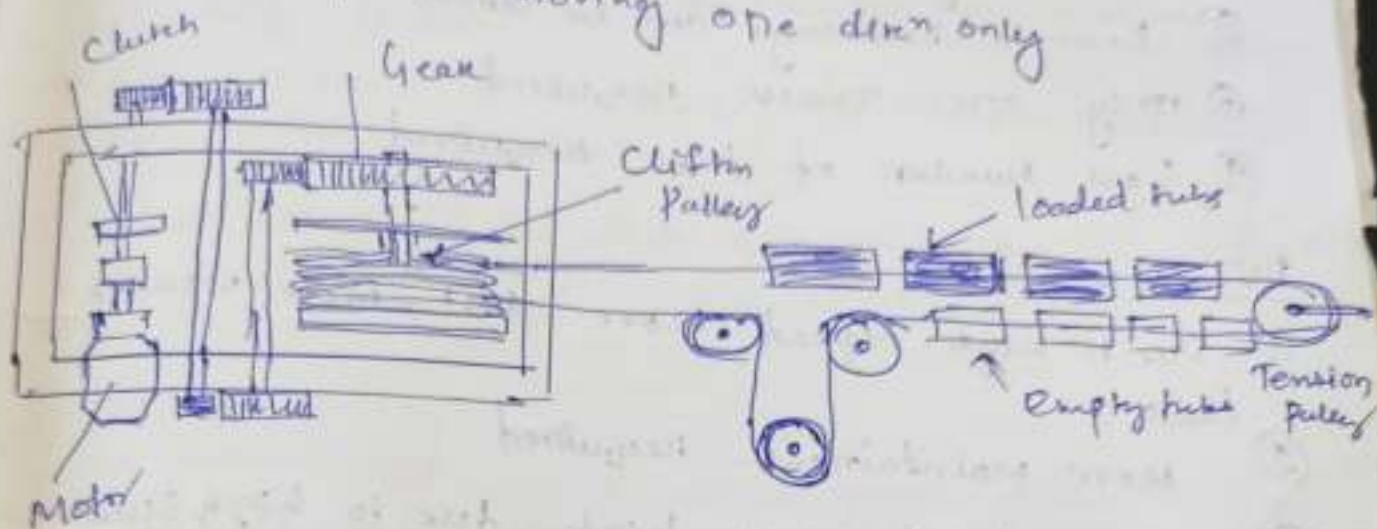
→ The attachment or detachment is performed by stopping the rope. If however, clips are used for single tubs they can be attached or detached when the rope is in motion.



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- The gradient of haulage road is mild and rarely exceeds 1 in 6.
- The rope speed ranges betⁿ 3-7 km/hr and the haulage is slow moving.
- The rope is moving one dirⁿ only



- ~~Two sets of road are~~
 - These are two types of Endless rope haulage
- (a) Over rope haulage

- If the rope passes over the tubs, it is known as over rope endless haulage, in this system rope is unaffected by wet floors liable to wear & tear.
- The rope is at better working height & a system is generally used for undulating roadways (Smooth wave)
- Here attachment of tubs made by lashing chains or goose neck clip or com clip.

Main & Tail

adv

- ① it can be used on less inclined & undulating roadway
- ② Branch roadways can be served
- ③ only one track required
- ④ Less Numbers of tubs required

Disadv -

- ① Due to high speed: More dust, more wear & tear
- ② More maintenance required
- ③ Derailment caused high due to high speed.
- ④ More power require due to Endless Syst

(b) Under Rope Endless Rope haulage -

- If the rope passes below the tubs, it is known as under rope endless haulage. In this system there is more wear & tear to this rope but also there is a more direct pull on the drawers, the tubs may be fully loaded.
- The method is suitable for steep roadways of uniform gradient.
- Here attachment of tubs are made by screw clip or smelment clip.

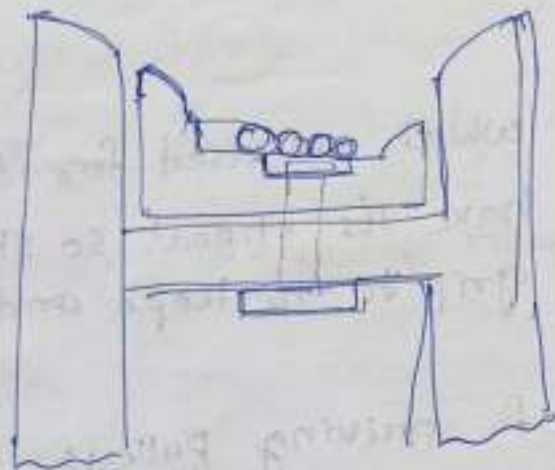
Driving Pulley

- Pulleys or wheels which are used for driving purposes on haulages must have its throat so shaped as to give the necessary grip to the rope and prevent jar and shock.
- Different forms of driving pulleys for endless are -

- ① Clifton pulley
- ② V-groove pulley
- ③ Flower's clip pulley

CLIFTON PULLEY

- The Clifton pulley is the type generally used in endless rope system.
- The pulley has a taper throat lining of removable cast iron or soft steel segments having a taper of about 1 in 8.
- These segments having a taper are secured to the rim by counter-sunk bolts and have side flanges to protect the main pulley flange from wear.

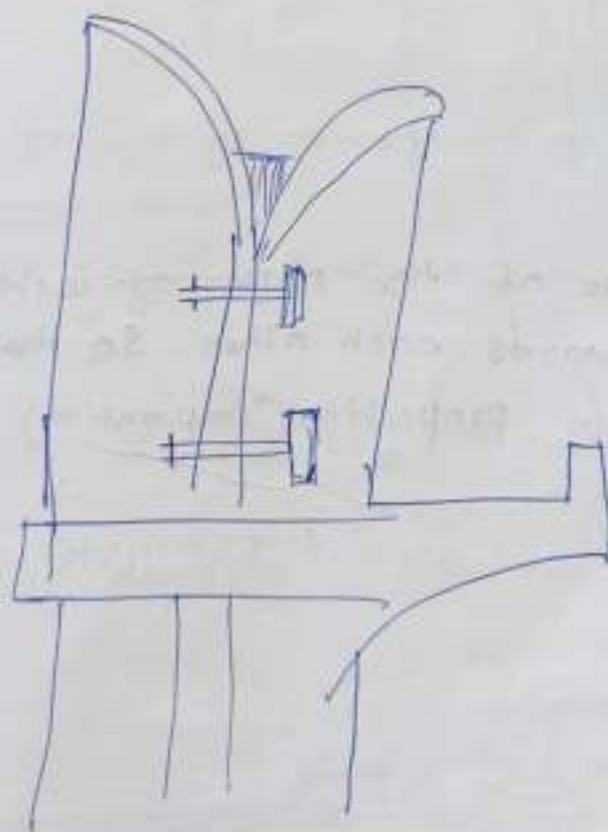


- Changing the liners is effected very quickly & cost of such liner is but fraction of the pulley cost.
- The incoming rope, pulling too a load is coiled (arrange in a coil) 2-3 times around the pulley & it enters the pulley at larger diameter & leaves the pulley at smaller diameter.

2. V Groove pulley -

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- V-groove pulley or clip pulley is suitable for light for light haulage.
- The pulley consists of two segments made of Renewable cast iron or soft steel.
- These segments are bolted to the main pulley in 'W' shape.
- The rope takes only a half turn around the pulley and takes necessary grip by becoming wedged between the two inclined segments.



- The grip on the rope is directly proportional to the tension in the rope.

3) FOWLER'S CLIP PULLEY -

→ It consists of ball shaped pivoted segments made of renewable cast iron or soft steel.

→ These segments made of renewable are pivoted (fixed) to the main pulley.



→ The pressure of the rope on bottom of the segment towards each other so that they grip the rope in proportion (comparative) to its tension.

ROPE CLIPS

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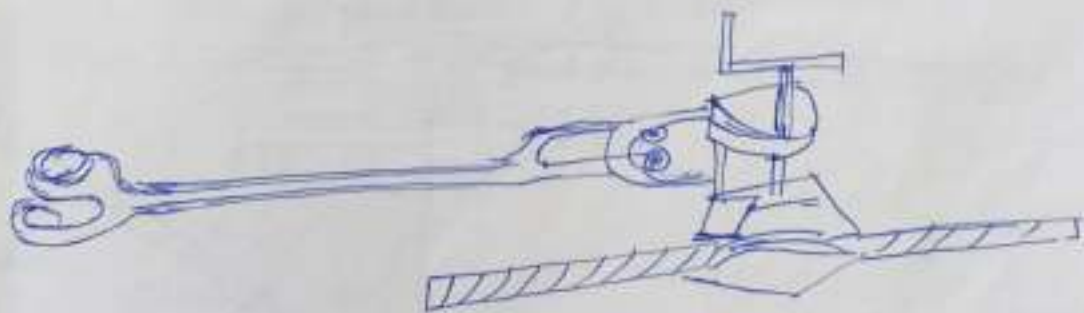
- The endless rope moves at a slow speed over pulleys or rollers situated between the rails in the haulage way.
- special clips are used for attaching tubs or cars to the moving rope. The design of
- The design of such clips depend on whether the rope travels under the tubs or over the tubs

(a) clips used for under Rope Haulage -

- ① Screw clip
- ② Small man clip

1 - Screw Clip -

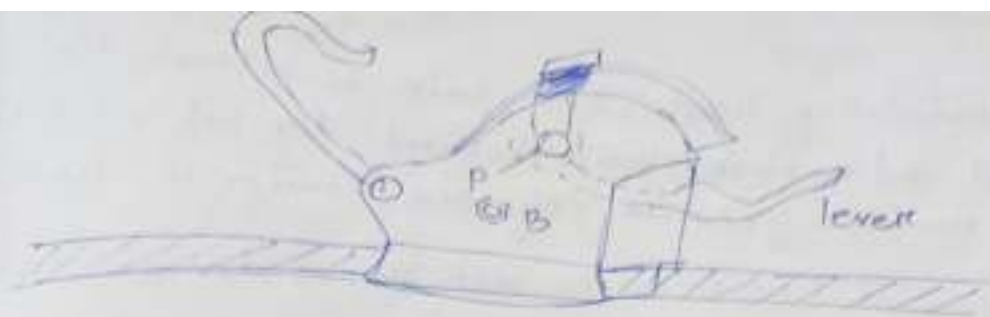
- The clip is tightened on the rope by a handle and screw
- The handle is couple the draw bar of the tub by a long steel rod hinged to the clip.



② Smallman Clap

A smallman clap consists of a pair of steel or side plates, loosely held together by an adjustable central bolt which has a spring surring it to keep the plates apart and kept in position by the pins supporting the lever and the coupling hook.

- The bent lever is pivoted at P and carries at its upper end a wedge A which works betⁿ curved surface
- The top of the clip is expanded by means of a specially designed lever-operated wedge
- When the lever is depressed, the wedge A enters the narrower part of the space betⁿ the side plate, so forcing them apart at the top, and at the same time causing the bottom jaws to grip the rope.
- ~~When the lever is raised~~ The clip is provided with a coupling hook to attach with hobs.



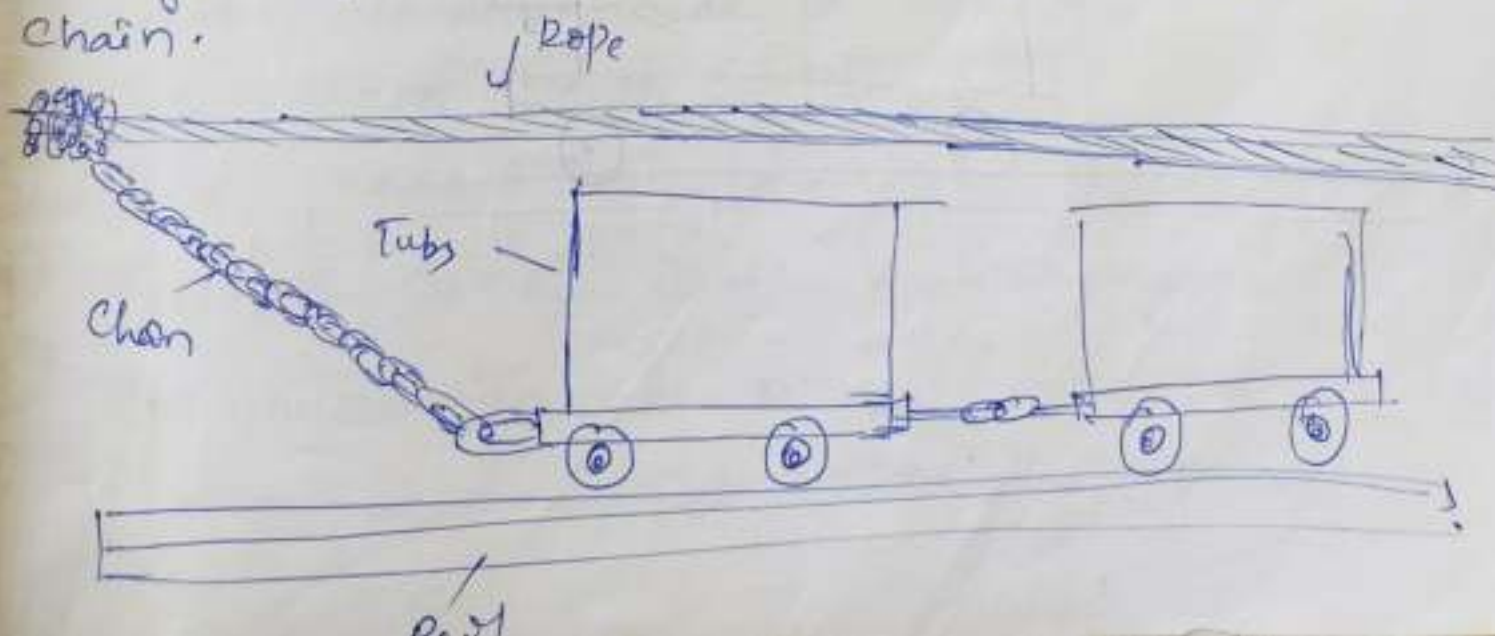
→ The clip can automatically detached from the rope by fixing a trip bar to a sleeper at some convenient height.

(b) Clips used for over-Rope

- ① Lashing chain
- ② Goose-neck clip
- ③ cam clip

(1) LASHING CHAIN -

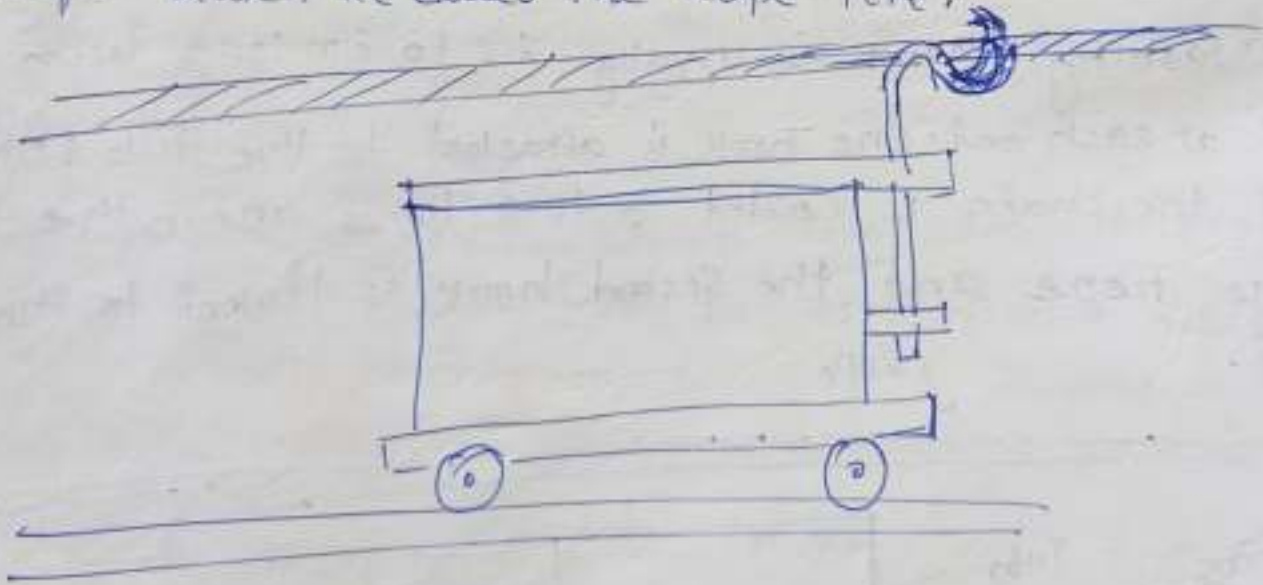
The lashing chain is usually 2.5 to 3m long with a hook at each end. One hook is attached to the tub, other end of the chain is coiled 3 to 4 times around the haulage rope and the second hook is linked to the chain.



- On undulating roads, one chain is attached in the front and another chain behind the set of tubs, but in uniform gradient only one chain is needed.
- It is a standard practice to attach or detach tubs when the rope is in motion.
- If the rope is to be stopped when attaching or detaching tubs, ^{lots} of timing was taken.

GOOSE-NECK CLIP-

- This is an S-shaped hook slotted into two ^{holders} ~~holders~~ on the end of the tub, or both end.
- When the rope is in position the hook turns through about 30°, so producing a local bend in the rope and thereby gripping it.
- The grip on the rope is proportional to the tension in the rope but this grip bends the rope which reduces the rope life.



3. CAMP CLIP



- This consists of a plate and a camp shaped lever which is pivoted and is connected by a chain to the tub to be hauled.
- The pull of the tub turns the lever around the pivot so that the grip of the clip on the rope is proportional to the load.
- on undulating roadways, clip must be provided at each end of the tub.

Advantage

- ① Less maintenance is required
- ② Less motor power required
- ③ Less wear & tear, because of low speed
- ④ Accident do not cause much damage
- ⑤ Continuous flow of mineral or coal is attained
- ⑥ It does not require heavy peak power

Disadvantages

- ① It requires wider roads for two tracks.
- ② Not suitable for steeper gradient.
- ③ Large numbers of tubs and clips are required.
- ④ It cannot serve a branch road.
- ⑤ If break down ^{of any tub} occurs, the whole system will stand still.

GRAVITY ROPE HAULAGE -

→ This is a haulage without any motor or external source of power and consists of a cast iron pulley, 1.3m - 2m diameter known as Jig pulley.

→ It is used when load is to be transported from up hill to down the gradient.

→ It consists of brakepath on one side.

→ It is located at top of the incline roadway, the one end of single rope is attached to the loaded tub and other end is attached to the empty tub will pass over the Jig pulley.

→ When the loaded tubs move downward by gravity at sometimes empty tubs move up the gradient.

→ When necessary the lever is depressed for the braking effect.

TYPES

→ Haulage greater any

→ For the

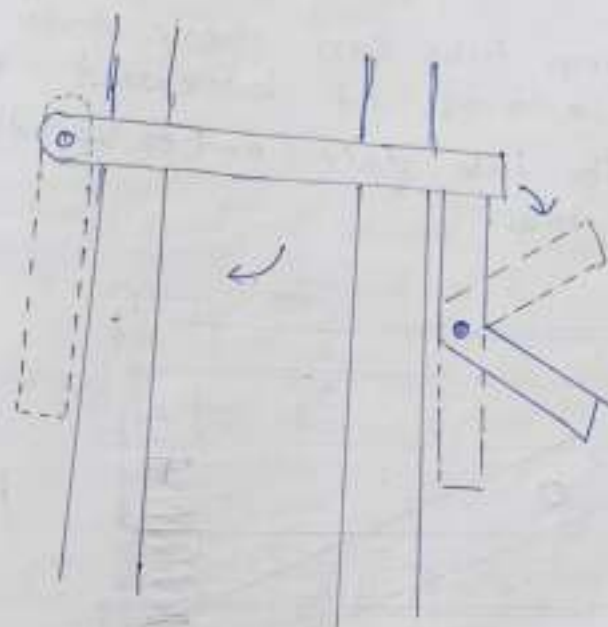
— way

①

TYPES OF SAFETY DEVICES ON HAULAGE ROADWAYS

- Haulage & transport operations have been responsible for a greater number of accidents involving death & injuries than any other single cause.
- For that various safety devices used on haulage roadways are as follows:-

① Stop-blocks



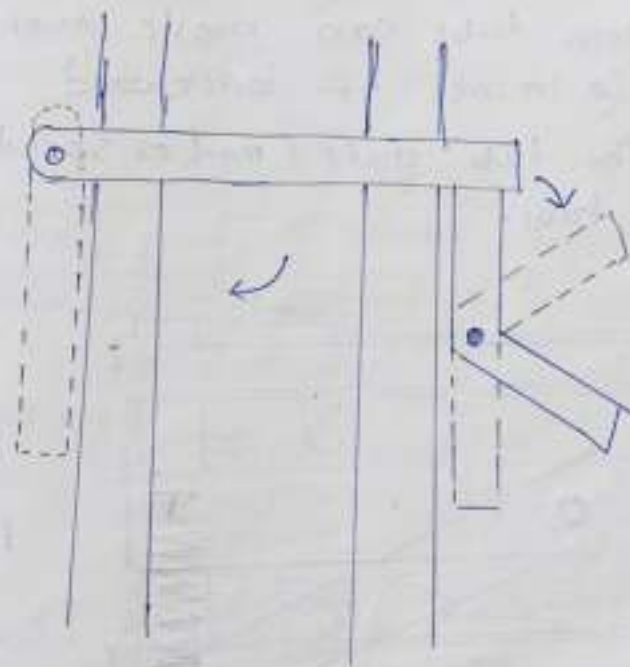
- This consists of a wooden beam or block lying across the rails, pivoted at one end and held against pivoted side block at other.
- The side block may be straight or bent. When it is desired to open the the block, side-block is first opened and then the stop block is turn as shown by arrows in figure.

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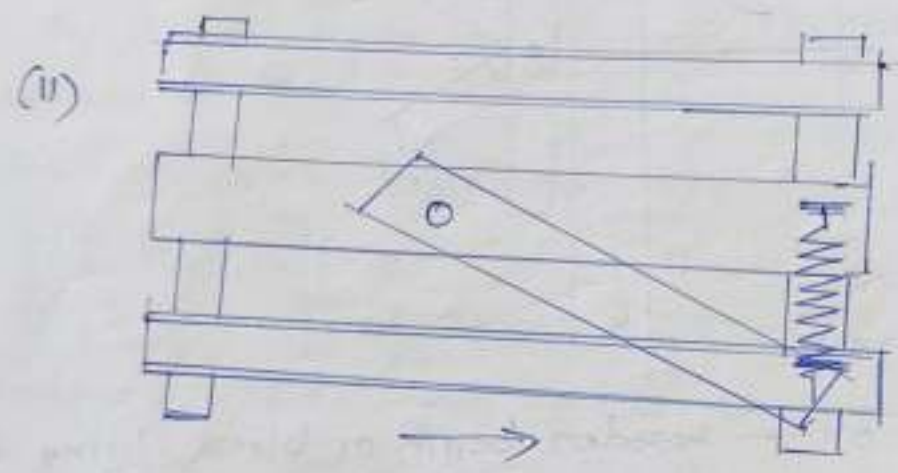
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② Back Catches / Runaway catches -



- These are made in different forms (i) a pivoted piece of steel rail placed between the track.
- In this system tubs can move over it only one direction. So in case of backward runaway it will catch the tub axle (rod or spindle) thus arresting the tubs.



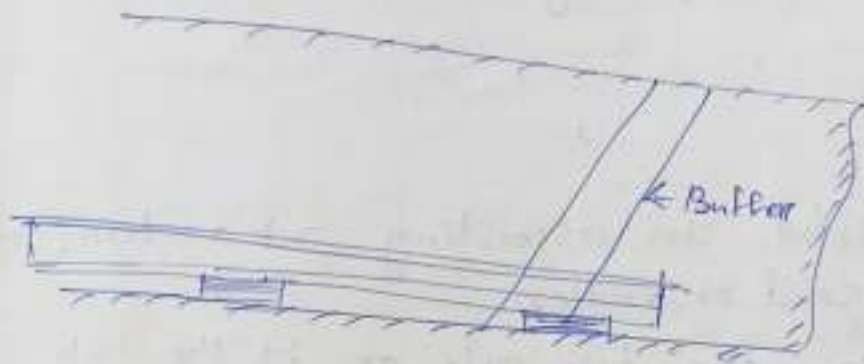
- (ii) A strong wooden block pivoted at one end and passed over the rail by a strong spring allows the tubs in one direction only and prevent runaway backward in case of spring catches.

③ BUFFERS -

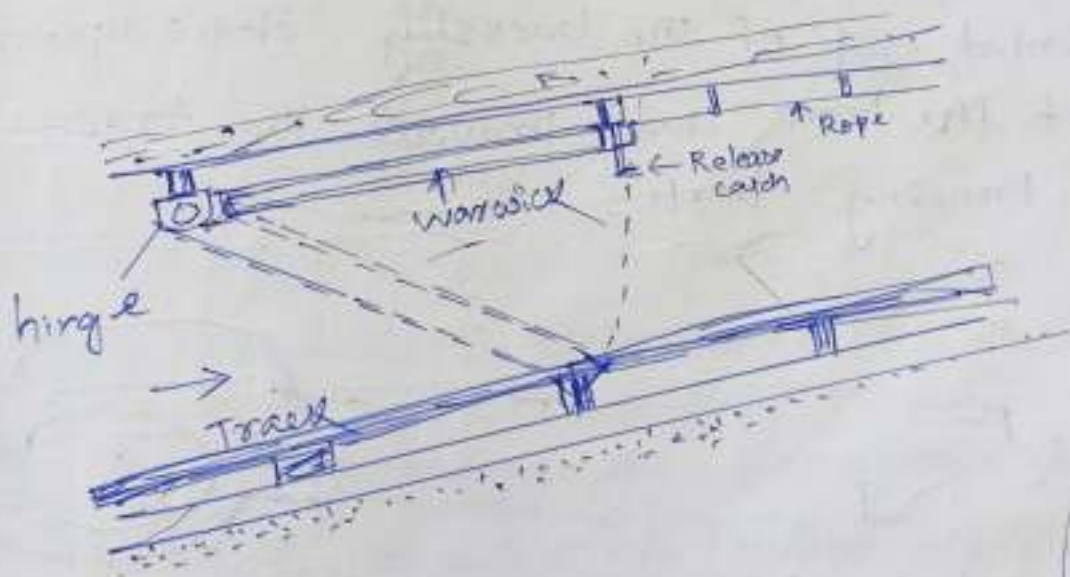
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When any roadway or face is in direct line with a haulage track and persons may be exposed to danger from run-away tubs, strong buffers is provided and maintained on haulage road to prevent such dangers.

— Buffer may be horizontal or vertical



④ DROP WARRICK - 15 ✓



→ This is intended for arresting, preventing a runaway, being placed below the roof of an incline. (B)

→ It consists of a heavy baulk (Timber beam) or Girder (Iron or Steel beam) at one end to a specially set roof girder and held up at other end by an eye bolt and pin.

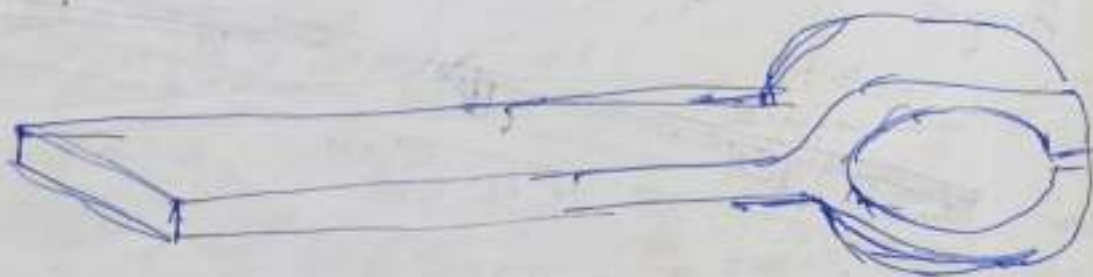
→ The Warwick is released when required in emergency by a haulage worker pulling the wire to withdraw the pin.

(C) BACKSTAYS

→ This is used behind an ascending set of tubs on a direct haulage road or endless.

→ It is attached to the tub axle or to the tub drawbar according to their types.

→ The pointed end of the backstay stops against sleepers of the track and prevent the train from running back.



HEAD 21 (CAGE AND SHAFT FITTINGS)CAGES-

- Cages are the vehicles for conveying empty tubs or cars into the mine and raising the full tub to the surface.
- They are also raising and lowering of all workmen, tools, materials etc.
- Cages are of very different pattern, their size and shape depend upon the size of the shaft, the capacity of tubs or mine cars, and the load to be raised per trip.
- A cage to hold one tub is of nearly square form, and to hold two or more on one deck it is rectangular form.
- Cages are made with from one to four decks or more and carry one, two or three tubs or cars on each deck as arranged.
- A mine car of capacity 2.5 to 3.5 Tons is normally used in underground mines.
- The cages are usually made throughout of mild steel for strength and robustness (strong).
- The use of aluminium alloy stiffened by mild steel members may reduce the weight of the cages.
- The cage accessories include (1) Hand Rads (2) Tub controllers and guides.

CAGE GATES OR FENCES

- Sliding cage gates or shutters which can be raised or lowered are provided to close the end of the cage when the men are riding.
- Gate may be in the form of bars and chain, with steel bars with two cross-pieces, three uprights and a diagonal brace are sometimes used to construct the gate which can be locked by sliding bolt.

TUB CONTROLLERS

- Rail are laid on the floor of each deck upon which the tubs stand in the cage.
- Tub controllers or catches are provided at each end of the decks to retain the tub or mine car in the cage when winding, various arrangements for the purpose may be used.

⑥ GUIDE SHOES

- To ensure smooth travel of the cage flange nose guides or rigid guides of wood or steel are used.
- The guiding devices or guide shoes are fitted to a cage.
- The following types of shoes are used for different type of guides
 - Shoe for wooden guides
 - Shoe for Rail guides
 - Roller shoe for rail guides
 - Shoe for rope guides.

WINDING DRUM

→ DRUM PROFILE

Power required for winding resulted in the use of various drum profiles or shape in order to afford the most efficient design.

4 types of shapes drum used :-

- ① Cylindrical drum
- ② Conical drum
- ③ Cylindro-conical drum
- ④ Bi-cylindro-conical drum

① Cylindrical Drum:-

A cylindrical or parallel drum is simple and robust in construction.

→ The winding rope is attached at each end of the drum barrel and arranged to coil on the drum in opposite direction. So that when the drum rotates one cage will be raised and the other lowered.

→ The rope coiling underneath (situated directly below) the drum called underlap and the rope coiling over the top of the drum is the overlap.

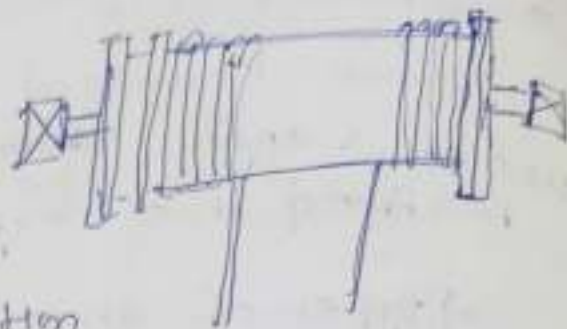
- The Sentow drawback is that it can be used for shallow depth.

Advantage -

- Better control of engine
→ Reduced Power Consumption

Disadvantage

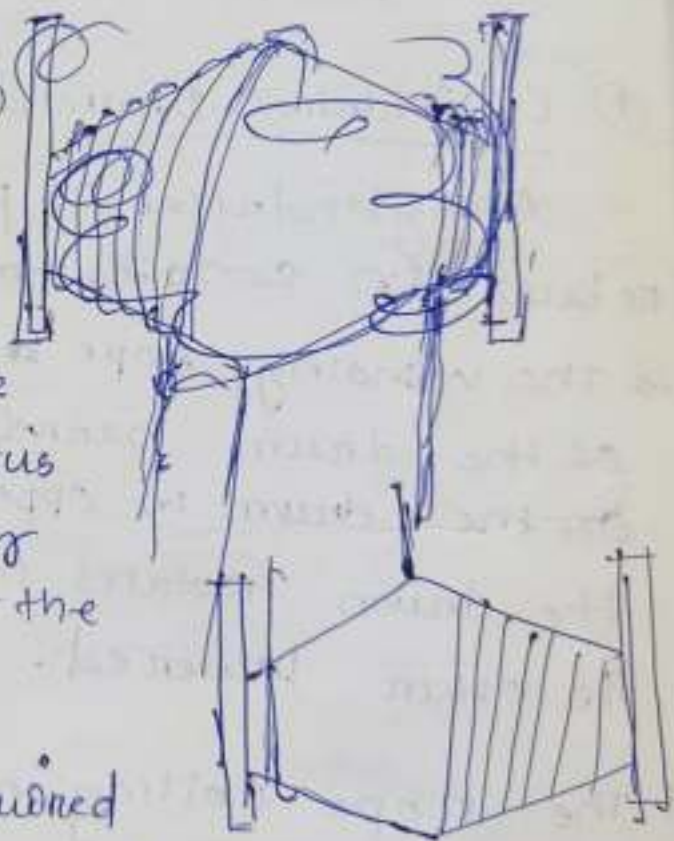
- Cost is more
→ Weight of Cappel is increased



② CONICAL DRUM:-

- It is provided with flanges on two sides of the conical portion for even coiling of rope.

- Rope supporting the full cage is coiled on the small radius and that holding the empty cage on large radius at the commencement of the wind



Advantages:-

- No Tail rope required
→ At the commencement of wind, torque against engine, Reduced Friction
→ Reduced Power

Disadvantage -

- Conical drum is that only the half width of the drum can be used for coiling at each rope.
- size of drum is large

⑤ Cylindro-conical Drum :-



→ This is an improvement upon the conical drum in which the apex of the conical portion is provided with cylindrical drum.

→ This is combination of a cone and a cylinder.

→ The ascending rope is wound on the smaller diameter of the cone at first, and as the engine reaches full speed after the period of acceleration, the rope wound on larger cylindrical part.

Advantage :-

- Conical section improves the balance system.
- Cylindrical section provides for additional space for coiling

Disadvantage -

- Design and operation is not smooth

① Drum - Cylindrical - Conical drum →



- The Drum composed of two cylindrical sections, one of small diameter and other is large diameter joined by conical section
- At beginning of hoisting period, the loaded rope is wound on a small cylinder until full speed attained, when the rope is transferred by the cone to large cylinder.
- Near the end of the hoist but just before the beginning of retardation, the descending rope is transferred from the large to the small cylinder.

advantage -

- Design is controlled the heating effect
- It reduces the peak loads on motor
- DTL like control of torque.

Disadvantages

- (a) It is heavier and more expensive
- (b) It can't be used for multi-dock cages
- (c) For deep winding the drum size becomes expensive

TYPES OF WINDING BRAKES

- (1) Mechanical
 - Postbrakes
 - Caliper brakes
- (2) ~~Plugging~~ Electrical
 - Plugging or reverse current brakes
 - Dynamic current brakes
 - Regenerative brakes

Mechanical brakes

Mechanical brakes directly acting on the winding drum are able to hold each of the cage in any part of the shaft without any aid of power source.

→ These are available in 2 categories -

- (1) Post Brakes
- (2) Caliper Brakes

POST BRAKES



→ Winding engines are generally controlled by fixed post brakes

→ The posts of the post brakes are made of roller steel jute and are pivoted at the lower ends,

→ The upper end of one being connected by a tie to one arm of a bell crank which is pivoted at the top of the other post.



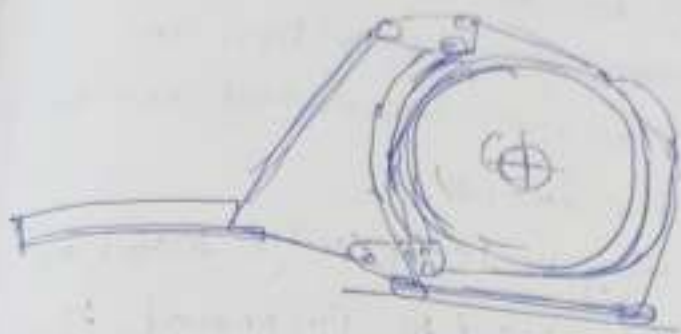
→ The longer arm of the bell crank is connected to the brake lever, so that when the lever is depressed the posts are pressed against the cast iron brake path mounted on one side of the drum.

→ The brake lever may be operated by hand or foot, but provision is generally made for automatic application of the brake when the overwinding occurs.

→ Wagon divided in 2 categories -

- ↳ Suspended curved post brakes
- ↳ Vertical Post Brakes.

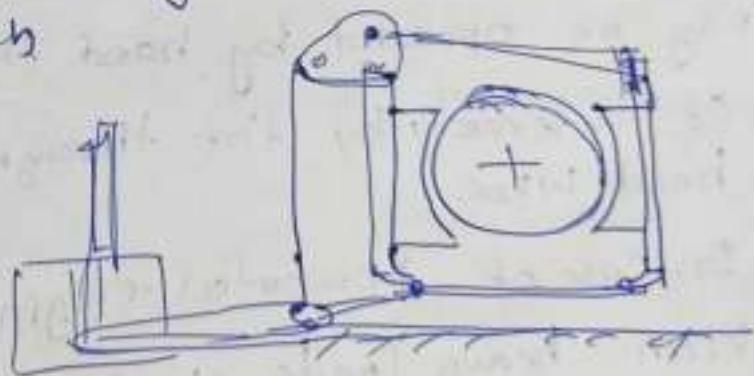
Suspended Curved post



These are much used on large winders and haulers.

- It consists of two curved steel posts provided with ferrod-lined brake-block shaped to fit the brake path on the circumference of the drum.
- The two posts are suspended above the floor-level by the pivoted arm and are interconnected at top and bottom.
- With this type of post brakes, the movement of brake posts is nearly parallel, and the brake take up is such

Vertical Post Brake



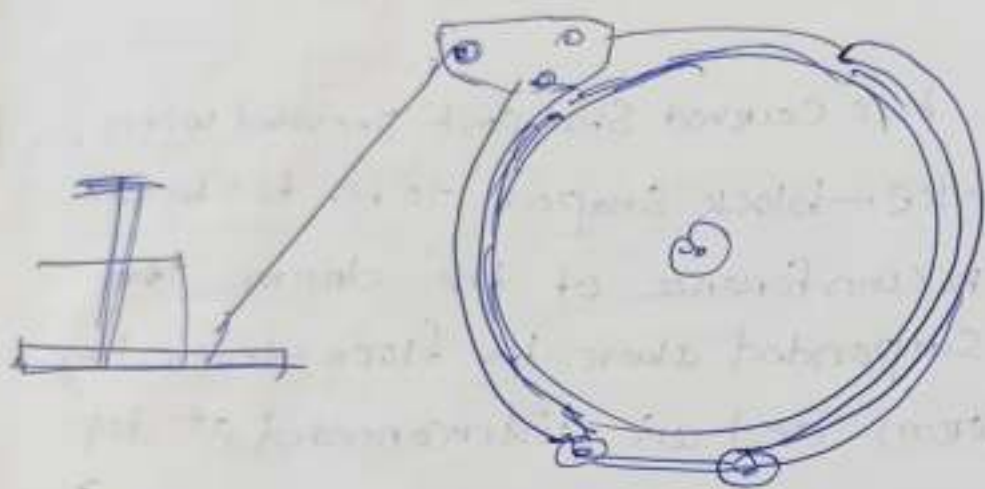
In vertical post brakes, the posts are vertical and their lower ends are anchored and thus a greater pressure is exerted at one end of the post.

- The brake lining then wear unevenly and requires more frequent renewal.

Caliper Brakes -

The posts are bent to conform to the curvature of the circular brakepath and as they are pivoted centrally below the drum and are bent over the drum the arc of

- The post ends may be lined with wood or Ferrodo lining may be used to improve the frictional resistance of the brake.



Operation :-

- The brakes of medium or low-powered engine may be operated by hand through the medium of a lever, by foot through the medium of a hand wheel.
- In case of powerful engines or motors dealing with heavy loads at comparatively high speeds the ordinary services brakes may be operated by steam & compressed air.

ELECTRICAL BRAKING

A brake is a device for applying resistance to the motion of a body, either to retard or to absorb and measure the power developed by an engine or motor.

→ Generally 3 types of electrical brakes used -

- (1) Plugging or reverse current braking
- (2) Dynamic current braking
- (3) Regeneration braking.

PLUGGING

→ It is effected by shifting the control handle to a position to the machine direction of movement.

→ Now, the stator magnetic field rotates oppositely to the rotor of the winding motor, thus resulting the braking torque to brake the winding system.

→ The plugging region covers steady portion of mechanical characteristics at high rheostat resistance in the rotor circuit.

Rheostat is an electrical instrument used to control a current by varying resistance.

DYNAMIC BRAKING
The dynamic braking is accomplished with by the disconnecting the stator from the A.C. mains and feeding with D.C.

- While stopping the rotor directly or through the starting rheostat.
- The stator forms the stationary magnetic field which induces AC in rotating rotor.
- (Influence) Interaction of this current with the stator magnetic field creates braking torque.
- which can be controlled by varying the value of DC and resistance of the rheostat all in rotor circuit.

Regenerative braking - It is effected as follows -

- The operator release the brake and the winder starts rotating under the action of the load being lowered.
- As the speed increases, the action of the load being lowered.
- As the speed increases, the operator shifts the winder control handle in the dirⁿ of normal rotation so that when the synchronous speed (ie 600 Hz or 500 Hz) attained, the rotor gets

started.

→ After the rotor speed exceeds, the motor braking torque starts increasing while the acceleration of the load being lowered decreases.

→ Regenerative braking can only be applied in the fast speed part of the winding cycle where the increase in cage speed is permissible.

VARIOUS SAFETY DEVICES

The safety and protective devices are used in mine winding system to protect the life of person riding the cage or working in vicinity of the shaft and also to protect the head frame, cage, motor and other equipment from damage.

List of safety devices of Winder

(1) Mechanical brake / friction brake:-

When considering safety devices this is the first device that comes to our mind and is required by Mining Regulation.

(2) Additional Mechanical brake - acting on the brake arm of the flexible coupling betⁿ the motor and the Gear box.

(3) Automatic Control valve :

Which prevents overspeeding, overwinding and ensures slowbanking as a speed not exceeding 1.5 m/s.

(4) Reverse direction prevention switch :- It trips power if when operating motor in wrong direction

(5) Time limit Switches at the pit top -

Mounted on headframe to trip electric supply to the motor, when overshoots the decking level.

(6) Rope deviation limit switch - used on multi-rope kope winder. If any deviation of rope occurs the power to motor tripped

① Tachometer generator on the gear box:-

In case of faulty gear box, the winding drum shaft does not turn at its normal speed and the tachometer generator will not generate sufficient D.C., which results in tripping of power to motor.

- ② Wedge arrester for downgoing cage
- ③ Safety catches mounted on the treadgear for the ascending cage
- ④ Safety detaching hook for ascending cage.

Friction Winding~~THE~~friction winder

The friction winder which is called Koepe winder the hoisting drum is replaced by a large single groove driving sheave some 4.5 m or 6 m in diameter

There are two types of Koepe winder

- (1) Tower-mounted Koepe winder
- (2) Ground-mounted Koepe winder

(1) TOWER-MOUNTED KOEPE WINDER →

In tower mounted Koepe winder the winding engine is erected at the top of the headgear, etc

→ The winding rope passes over the top pulley, usually capped Koepe pulley, on which it is carried in a groove and the driving transmitted by friction betn the rope and the driving pulley

② It consists of a single rope passing over a friction pulley which is electrically operated & installed at the top of the hoistgear,

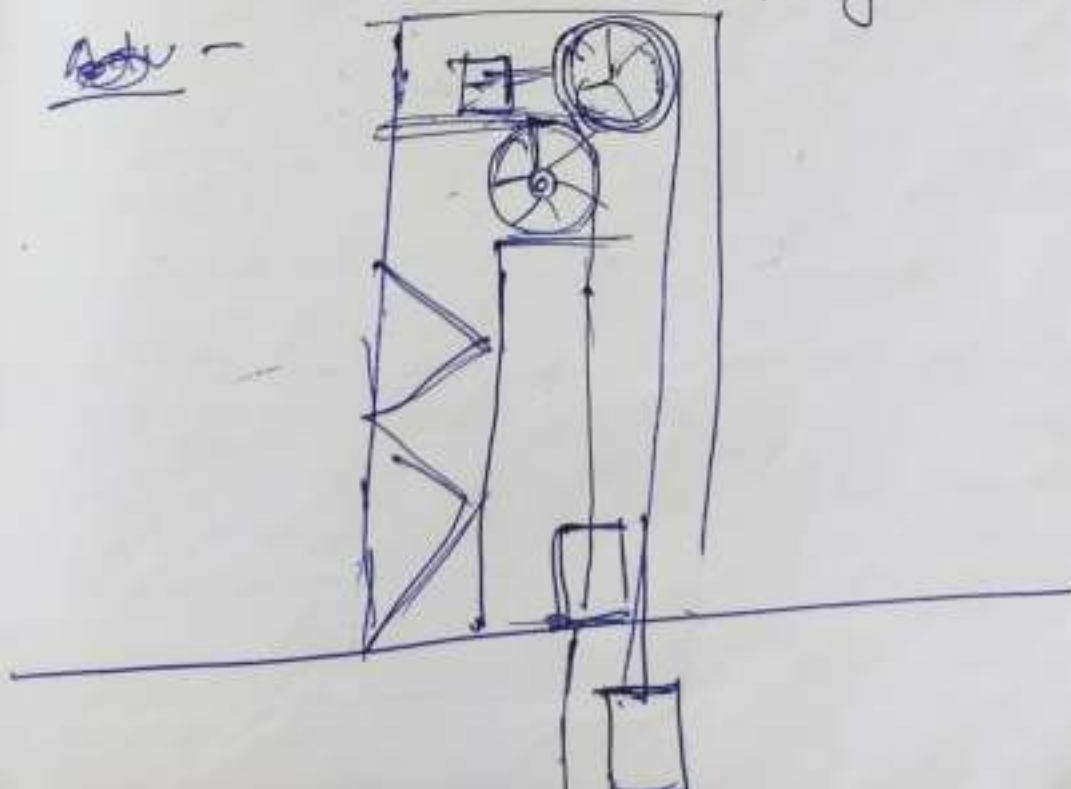
③ A deflecting sheave or guide pulley, placed below the top pulley.

→ The two ends of the rope pass over the pulley and connected with the cages.

→ The ~~rope~~ winding engine, the koepe pulley and driving motor, together with the deflecting sheave or guide pulley are supported by the tower built over the shaft.

→ A balance rope is always used with a koepe winding. This is hung below the cage or steps. The system therefore completely balanced.

Adv -



SKIP WINDING

Skip →

Skip can be filled with mineral through its top opening skip travelling in a vertical plane have exits at discharge opening at bottom for unloading the mineral content

→ skip moving in a vertical plane are sometimes positioned for accommodating men at the upper half and material/mineral at the lower half.

→ Skips are provided with cast steel guides shoes having Malleable cast iron brushes, usually four shoes per cage or skip.

→ The skip carries a large payload, usually 8 ton or more, compared to the cage & the ratio payload/gross weight of skip (loaded) is high for skip.

Adv -

① They are made to travel in vertical plane and also inclined plane

② Skip winding is best suitable for deeper shaft

Where high output is desirable

③

Skip Winding

In skip winding the cars need not be drawn up the shaft and arranged at the banking level for discharge.

- Skip may be used in either vertical or inclined shaft
- The skip includes a frame, a body and a suspension device attached to the frame, made from channels or a body suspension device and guides
- The body is welded or riveted from sheet steel, 6 to 10mm thick

→ Inclined shaft skips - are of heavy construction for iron and copper ores, for convenience loading the angle at forward end is made approximately equal to the dip of shaft

Vertical shaft skip - are almost universal for large output.

- The essential feature of skip winding system is that the coal or ore is discharge from tub or mine car at the shaft bottom by tipping into hoppers, from which loaded into ~~receiving~~ hoppers skip in bulk, wound to the surface and their discharge into receiving hopper from which it is transported by belt conveyor to the required destination.

Types of Sump

- ① Bottom discharge sump
- ② Top discharge sump

BOTTOM DISCHARGE SUMP

It consists of a container which by means of longitudinal struts is suspended in head structure

- Above and below the container and arranged one or two decks, provided that the installation is for regular man-riding
- During product winding these man-riding decks, which are of winged type, are pulled up
- Discharge is done through a bottom flap which is automatically opened when the sump moves into unloading position
- The flap is automatically closed when the sump moves away from its unloading position
- For the ore mining industry sump ~~is the~~ ^{have been} ~~Swamp~~ containers developed that are specially protected against the impact and wear due to ore charging. Such protection is achieved by a wooden lining ^{between} the wearplates and the outer wedge of sump.

wear used.

The sump

in place

The top have

Adv

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near resisting flammable rubber or plastic are also used.

- The loading of skips is arranged either from skip pockets or from conveyor at the pit bottom. In each case the skip load is measured out and placed in position during the wind.
- The best plan is to empty the cars, in tubs, hoppers or side discharge hoppers, without having to uncouple them.

Advantage -

- ① Higher ratio of payload to deadload.
(A skip weigh is less than combined cages can load)
- ② Shorter decking period, ~~skip~~ skip winding allows more ~~skip~~ wind / hour which results in increase in output.
- ③ Reduction in manpower. (Filling & emptying of the skip is automatically),
- ④ Smaller shaft space occupied
- ⑤ Fewer tub & mine car required
- ⑥ Better performance and economic installation
- ⑦ Greater winding depth, negotiated

- ⑧ cost maintenance & Repair change minimum
- ⑨ Stop can travelled vertical & inclined.
- ⑩ Fully automatic installation

Disadvantage :-

- ① Separate arrangement for men & material
- ② possibility of increased breakage of coal during loading & unloading
- ③ A high headgear is required and shaft sunk deeper
- ④ The dust generation by loading & unloading may create a problem.
- ⑤ Initial cost is high due to installation of hopper, tripper etc.
- ⑥ Difficulty to dealing with different grades of coal.

PIT Top Circuit layout

Mine car winding installations may be divided into two classes according to the method of handling of car in pit-top.

- ① With Tippers near to the shaft (LoCo System)
- ② With Tippers away from the shaft

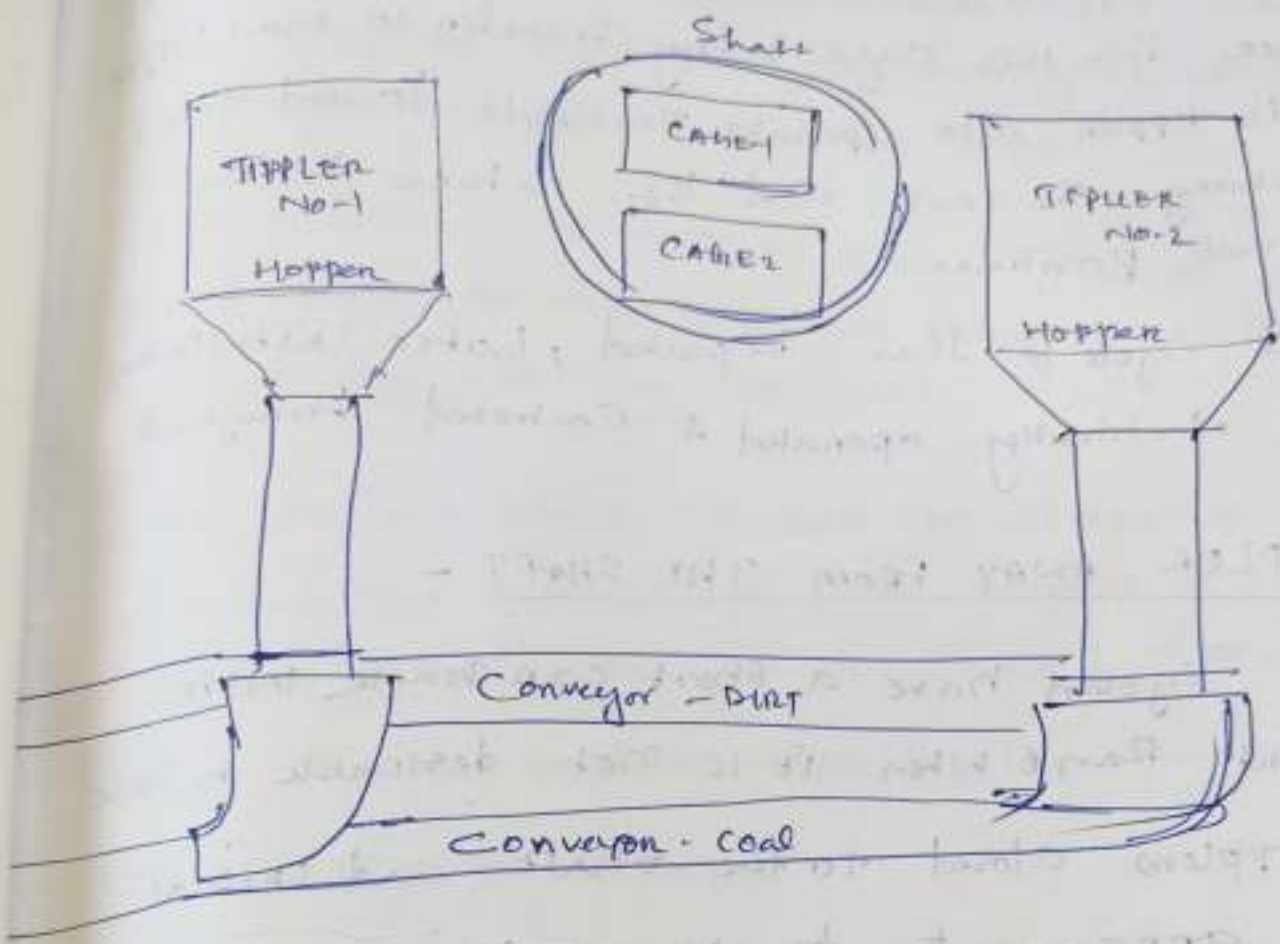
① LoCo System

This installed first time in - Lofthouse Colliery, Wakefield, Britain.

→ In this mine cars never leave the neighbourhood of the shaft side

→ Being rammed from the cage cars move into a tippler during the subsequent wind and then returned to the mine when next cage arrives to surface

→ The system is based on the use of two large tipplers as shown in the figure or two double tipplers, one on each side of the shaft.



→ If the system, an empty mine cage from No-1 Tippler is returned into cage-1 and the loaded cage from the cage transferred to No-2 Tippler

→ During wind, the tipplers operates towards the loaded side, discharging the coal into the hopper and returning to the normal position by the time of second cage is arrived.

→ At this stage, the empty car from the other side No-2 tripper is rammed into cage-2, the loaded car from this cage being transfer to No-1 Tripper. This tripper also operates towards loaded side, discharge the coal and then returns to the normal position.

→ This cycle is then repeated, Lofco installations are electrically operated & controlled throughout.

② Tripper Away From THE SHAFT -

These systems have a short car track with straight runs when it is not desirable to have the trippers closed to the shaft and include some arrangement to change the direction of motion of the car in the circuit.

→ The method for circuit include

- ① Continuous circuit method
- ② Shunt back method
- ③ Reversal of car travel method
- ④ Traverse method.

Pit bottom lagoue

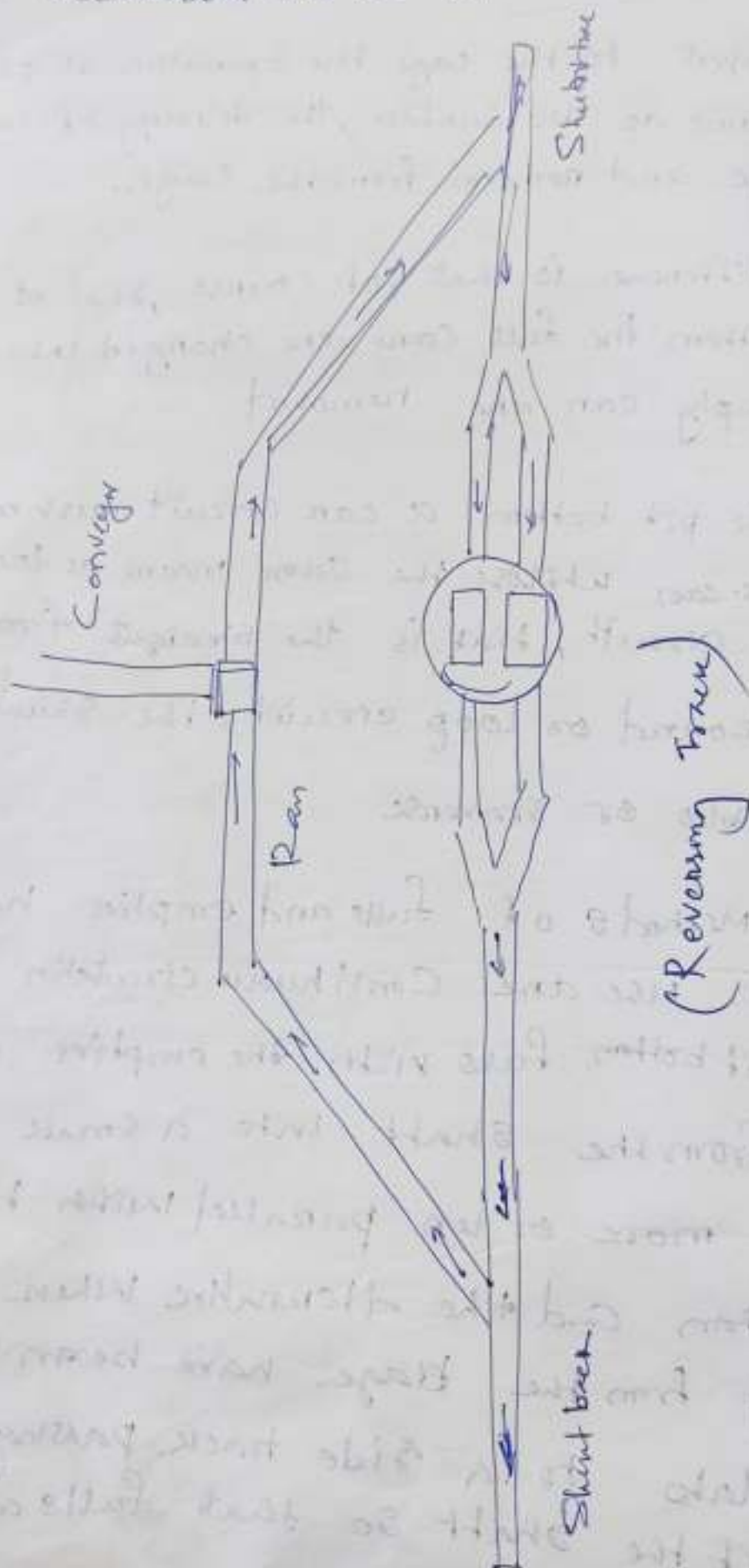
With respect to the cage the operations at pit bottom is the same as the surface, the delivery of cars into the cage and removal from the cage.

→ The difference is that, of course, that at the pit bottom the full cars are charged into the cage and empty cars are removed.

→ At the pit bottom, a car circuit must be arranged and this can utilize the same means as does the surface circuit, that is the straight forward run round or loop circuit, the shunt back, turn table or traverse.

→ Two methods of full and empty handling in common use are continuous circulation through the pit bottom full with the empties going away from the shaft into a small section tunnel more or less parallel with the main pit bottom and the alternative when the tugs are ejected from the cage have been slid over iron plates to a side track passing on one side of the shaft so that full and empty

Arve accomodated into the pit bottom.



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Shunt Back

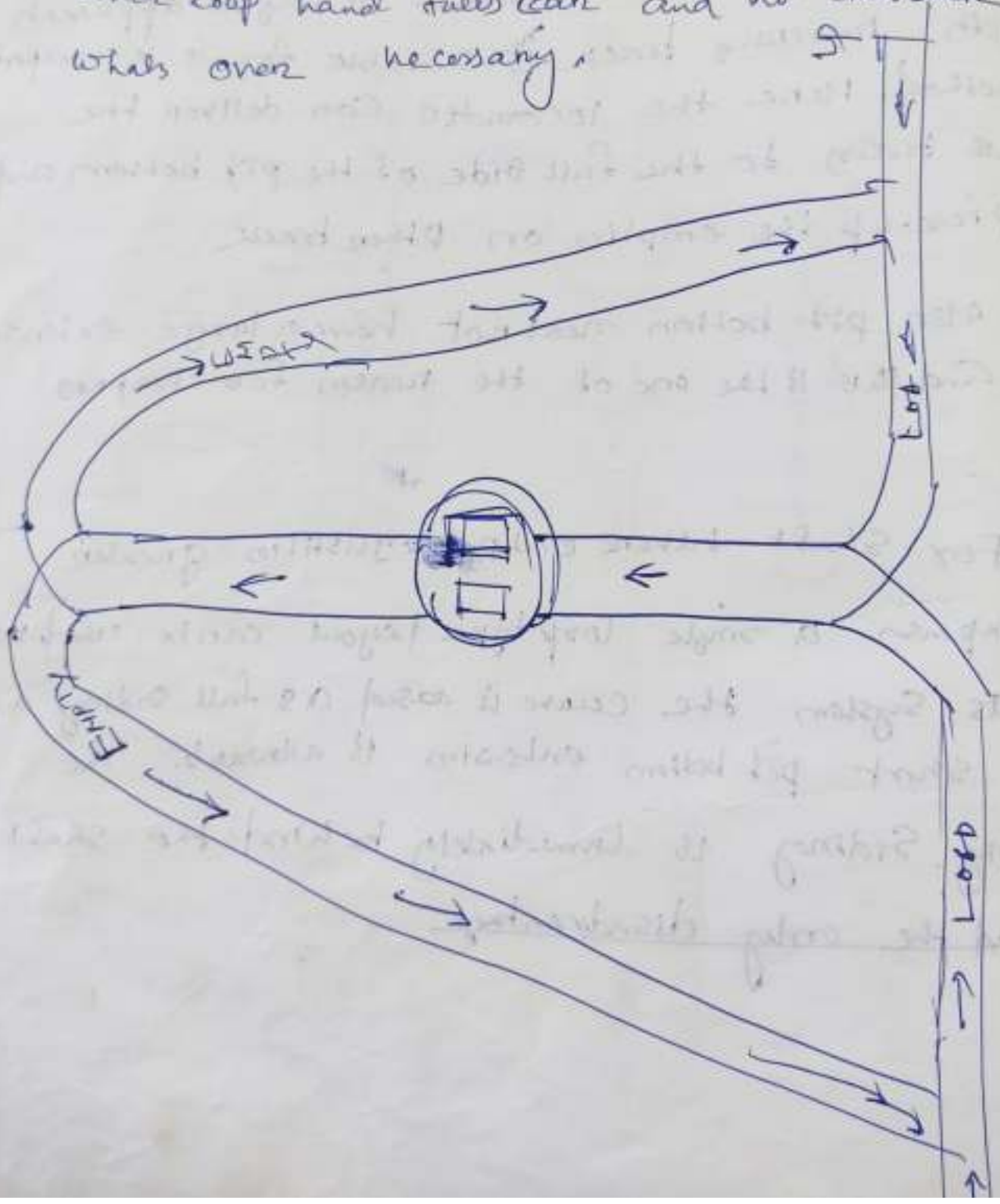
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The use of Shunt back can result in an economy in space required. In principle, its action is very simple, the track being elevated and its ends so that the car running on it is slowed and stopped and then back again by the action of gravity.

- For shaft with small output a single approach with reversing track is suitable for it is cheap method, hence the locomotive can deliver the full train to the full side of the pit bottom and pick up the empties on other track.
- Also pit bottom need not have a large extension and this is the one of the reasons for cheapness.
- For shaft where output justifies greater expense a single loop type layout can be used, with this system the curve is used as full siding and a short pit bottom extension is allowable. The empty siding is immediately behind the shaft and the only disadvantage.

→ Where the output is from both sides a double loop layout can be used, this is most expensive form of pit bottom but for very large outputs from both side it can be achieved,

↳ This system is conducive to smooth turning for one loop handles only empty, while the other loop handle fuel can and no crossover what's over necessary,



LAYS OF WIRE ROPE

- Lay means used in relation to a strand indicates the direction of laying of wires, in the strand
- There are two types of lays.
- The Right hand lay
 - The left hand lay
- In right hand lay the wires spiral round the core in the ^{right hand} same direction ~~as~~ of and strand are also in same direction



- In left hand lay the wires & strand spiral round in opposite direction.

