

NEW ZEALAND RAILWAYS

ENGINE DRIVERS CORRESPONDENCE COURSE

Ab CLASS STEAM LOCOMOTIVES

LESSON NO. 7

In this lesson it is proposed to cover boiler failures and the necessary action required. The second portion of the lesson will deal with locomotive breakdowns and adjustments.

BOILER FAILURES

(1) LEAKY TUBES AND SUPERHEATER FLUES

To prevent tubes or flues from leaking, fire evenly and keep the fire in good shape and free from holes. When cleaning the fire, close ash-pan dampers, etc., and use the blower as little as possible. The injector should not be used while the fire is being cleaned.

If the tubes or flues are leaking slightly, careful firing and keeping a hot fire may help the leak to take up. If they are leaking badly, the best policy may be to reduce the load early, and get home with the important part of the train. Alternatively, it may be advisable to send for relief at once rather than risk delays to other trains due to late crossings. When only one or two tubes in an accessible position are leaking, plugging should be resorted to.

(2) FAILURE OF BRICK ARCH

When a brick arch collapses, it is advisable to stop at the nearest convenient place and remove the fallen bricks from the firebox. By continuing and attempting to remove the bricks a few at a time the fire invariably gets dirty and time is lost cleaning it and raising steam.

If near its destination when the arch collapses, the locomotive may be run to the depot before the bricks are removed.

(3) DEFECTIVE STEAM PIPES

If a copper pipe becomes defective on the road and its position is such that the steam supply cannot be cut off, the pipe should be flattened at both ends. Should a cast-iron steam pipe become defective on the road and difficulty is experienced in carrying out repairs, the train should be taken to the nearest siding and a relief engine sent for, rather than risk serious delays.

LESSON NO. 7(4) DEFECTIVE BLOWER

The majority of blower failures are due to pipes bursting or the end of the pipe blowing out, in which case the pipe should be cut off and turned up the funnel, contracting the opening in the pipe as much as possible.

If a blower becomes inoperative and the locomotive has a full head of steam, no trouble should be experienced in working the train to its destination if firing is done judiciously.

(5) DEFECTIVE SAFETY VALVE

If a safety valve is defective, the most probable cause is a broken spring. If the valve is not broken, place a piece of wood between the valve and the bridge and tighten down the bolts. By this means the locomotive can run to its destination. If the valve itself is broken and cannot be resealed, the locomotive should be prepared for towing.

(6) DEFECTIVE WATER GAUGE

Defects in the water gauge are due to lack of proper attention. All cocks and passageways should be kept free from dirt and scale and care taken to see that the steam and water cocks are properly open.

(7) DEFECTIVE FIREBARS

Firebars frequently fall into the ash pan, due to warped and twisted carrier bars. Carrier bars should be inspected regularly, and if showing signs of warping or twisting, or if the supporting brackets show signs of working loose owing to defective studs, the defects should be booked for attention. If one or two bars break and spares are not available, the remaining bars should be spread out evenly to fill the gap.

(8) BOILER PRIMING

Should priming occur, the cylinder cocks should be opened, the regulator valve just opened off the face, and the reversing lever placed full out. Strict attention must be paid to the water level in the boiler and to valve and cylinder lubrication when priming occurs.

If the boiler primes excessively due to impurities in the water, the trouble may be minimised by using the blowdown cock at frequent intervals.

Five minutes' blowdown before a locomotive leaves the depot will remove any sludge that may have accumulated in the boiler, and similar treatment on the road will prove beneficial in every way.

Locomotive Supervisors must ensure that blowdown cocks are used to the best advantage.

LESSON NO. 7(9) CLACK VALVE STUCK OPEN

If a boiler clack valve is stuck open, it may be seated by opening and closing the injector a few times. If this fails, a smart tap on the bottom flange of the clack box with a piece of wood may cause the valve to seat.

If the valve will not seat, the water valve and overflow valve of the injector should be closed.

(10) REGULATOR UNCOUPLED

If the regulator becomes uncoupled in such a way that it is out of control, and the valve is open, admission of steam to the cylinders may be regulated by means of the reversing lever, but it is advisable to reduce steam pressure. When stopping the locomotive, place the lever in mid-gear and control the train by judicious use of the brakes.

If the regulator becomes uncoupled in such a way that it is out of control and the valve is closed, assistance should be obtained from the nearest depot.

In some cases the use of a live-steam valve or drifting valve may enable the locomotive to be worked to the nearest station or siding.

(11) SMOKE-BOX DOORS

See that the faces are free from ashes and that ashes are not lodging in such a position that they will foul the faces when the door is closed. Then tighten the clips gently all round until the door faces are together, and finally tighten all clips firmly. The studs should be greased periodically to facilitate opening and closing the doors.

It is extremely important to ensure that the smoke-box door will not draw air, but if the door is warped a leak at the top is less harmful than one at the bottom.

(12) ASH HOPPERS

Ash hoppers fitted to the smoke boxes of locomotives with Waikato spark arresters should be cleaned at the end of each run, and care taken to see that the ashes which accumulate around the side of the smoke box in the outer passage as well as those in the hopper are all removed. Two inspection doors one each side of the smoke box, are provided to facilitate cleaning the outer passages and this work should be performed by means of an air hose.

Care should be taken when closing the ash-hopper door to see that both faces are free from ashes and that there are no ashes which are likely to fall between the faces when the door is being closed. Both lug nuts should be tightened evenly and not pulled up too tightly, thereby damaging the threads. On no account must the smoke-box door or ash-hopper door of a locomotive be washed down with cold water after cleaning. Cold water should never be used on hot surfaces that have any tendency to crack or buckle; the use of an air jet or a hand broom is recommended for this work.

LESSON NO.7LOCOMOTIVE BREAKDOWNSFIRST STEPS : CLOSE EXAMINATION : NATURE OF DEFECTS :

In the event of a locomotive breakdown, the Enginedriver before attempting any remedial action, should make a close examination of his locomotive to ascertain the full extent of the damage sustained and the steps he should take to effect repairs. Once he has surveyed the damage and formed an estimate of the likely time to move his train to the nearest siding to clear the main line, he is in a position to give the Guard or Fireman definite instructions so that positive action can be taken to advise all concerned as to the nature of the damage sustained, the probable duration of the delay, whether assistance is required and whether the train should be protected, according to the rules. The initial time spent in a calm inspection of the locomotive will be well repaid by the knowledge that all his subsequent actions are based on a clear understanding of the steps that are necessary to deal with the position.

POSSIBLE SOURCES OF TROUBLE:

The troubles experienced in every day service on locomotives are those ordinarily due to wear and tear, or to bad water or poor quality coal. These may cause the valves and pistons to leak and "blow"; the moving parts of the machinery to "pound" while in motion; the locomotive to steam poorly and the injectors to fail to work and the boiler to prime or foam.

The degree of danger to the operation of the locomotive in respect of any of these defects will depend upon the extent to which the defect has been allowed to advance.

In the case of a "blowing" valve or piston, there is usually little danger in running, provided that it is due to simple wear and not to a broken part. Where the pounding is light, there may be no immediate danger, but this defect will become worse if not attended to and if permitted to become excessive, a breakdown may be the result.

Where the water is of such a character as to cause the boiler to foam or prime, there is danger that water may be carried over to the cylinders and cause serious damage there.

A poor draught on the fire, caused by some smokebox defect, may cause delay to the train, but is not usually serious structurally.

It should always be remembered, however, that any defect, no matter how slight, may be the direct cause of greater ones, which result in a serious breakdown, and even disaster.

LESSON NO. 7THE DUTY OF THE ENGINEDRIVER WHEN DEFECTS NOTED:

When any of the defects previously mentioned are noted, the Enginedriver should observe them closely, and if they indicate a dangerous state of affairs, he should bring his train to a stop immediately. Should there be no apparent danger of an immediate breakdown he should proceed to the terminal and report the defect in the Rapair journal, and if necessary, make verbal representations to the Locomotive Supervisor or his Assistant.

Breakdowns can be minimised by inspections at intermediate stops. Particular attention should be paid to rods and brasses, especially the connecting rod "little end" brasses, because they are comparatively small, and therefore liable to "slack back" or even break. The keyway in the piston rod at the crosshead, the tyres, and in fact all moving parts, should be inspected as far as time will permit. This inspection is especially important in view of the high speed at which our modern locomotives are run.

All locomotives are supplied with equipment suitable for dealing with breakdowns. In consequence, if the breakdown is not too serious, the Enginedriver can immediately set about effecting sufficient repairs to get his train to the next station or siding, or even complete its run to the terminal.

In the case of heavy breakdowns or derailments, which involve such breakdowns as broken driving axles, leading or trailing bogie axles, broken tyres or failures involving heavy work, it may be necessary for the Enginedriver to send for assistance. In this case, the Enginedriver must use the most expeditious means of contacting the nearest Locomotive depot or Train Control Officer, giving full, but concise details of the nature of the failure and the class of assistance required.

The fact that assistance has been sent for in such cases does not relieve the Enginedriver of the responsibility of using all the means at his disposal to prepare his locomotive for removal from the section.

EFFECTS OF REMOVING THE SIDE (OR COUPLING) RODS:

The side rods, in addition to distributing the thrust of the piston equally to all crank pins, also performs the important function of keeping the crank pins in their proper relation to one another when either side is passing dead centre.

If the side rods are all in place, and those on one side are on dead centre, the others on the opposite side will be on either the top or bottom quarter. The rods on the dead centre are practically idle at this instant and exert no power, nor do they assist to turn the wheels; the side rods on the quarter are doing all the work. As they move off the centre, however, both sides are at work until the other side reaches the dead centre, when the conditions outlined above, are reversed. Consequently, if the rods which happen to be on the dead centre are removed, the others opposite will force the wheels around until they reach the centre, and if the locomotive is barely moving (or has no momentum) here, they will stop. With the pressure against the piston, and with the side rods in either front or back dead

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centre position there would be nothing to force the wheels in any particular direction. They could turn one way just as easily as the other. If they all turned in the same direction, no risk would be incurred but if the side or coupling rods get out of trammel the wheels would lock, crank pins could be damaged and the side rods would bend and create serious difficulties in uncoupling the locomotive.

The object lesson which should be firmly fixed in the mind of the student is that in every instance where it is necessary to remove a side rod or rods the corresponding rods on the other side must also be removed.

If one connecting rod breaks and no damage is sustained to any other rods, nothing need be taken down except the broken rod, as in this case the wheels will be forced to turn in the same direction because all the side rods are in place.

When uncoupling a locomotive, remember to keep the following two points firmly fixed in your mind -

- (1) The connecting rod can be run one sided with safety.
- (2) The corresponding side-rods on both sides must come down.

The speed of the locomotive must be reduced if towed without side rods as otherwise the unbalanced driving wheels may cause damage to the rails.

BLOCKING THE CROSSHEAD ON "Ab" CLASS LOCOMOTIVES

With the "Ab" locomotive the crosshead must be blocked forward. The crosshead is blocked forward for the following reasons:-

The leading crank pin will not clear the crosshead in all positions.

The checks are made so that the crosshead can only be blocked forward.

To give uniformity of practice.

If the leading coupling rod breaks, both crossheads must be blocked forward, and the locomotive prepared for towing. In the case of the "Ab" class locomotive because of the location of the knuckle pin, all side rods on both sides must be removed.

In the case of the "Ab", if the leading crank pin breaks off flush with the wheel, the connecting rod on the disabled side can be used. Remove all coupling rods, both sides, and the connecting rod on the good side. Block that crosshead forward, centre and secure the valve, remove the eccentric rod. Union link and lifting links, block cylinder cocks open, It will now be possible to proceed with the connecting rod up on the damaged side to the nearest siding, or to the depot if circumstances permit.

TAKING DOWN CONNECTING ROD:

In the event of a failure that requires the connecting rod to be taken down, proceed as follows:

Place the locomotive on the disabled side in a position so that when removing the little end pin it does not come in contact with the spoke of a wheel; also see that the main crankpin on the other side is in a position that will permit the locomotive to be started after the rod has been taken down. This crankpin should be somewhere between the back dead centre and the bottom quarter.

Next remove the split pin and the nut or nuts from the little end pin, (depending on the type of assembly) remove the union link, and drive the pin out, then pry the crosshead forward away from the rod. The front portion of the rod may now be rested on the bottom guide bar.

After the front end is disconnected, remove the eccentric-rod from the bottom of the expansion link and the eccentric crank from the main crankpin.

The back end of the connecting rod can then be pried off the crankpin, provided the front end is also pried outwards at the same time, thereby preventing the rod from binding on the pin.

When removing the eccentric crank arm from the crankpin, remove the bolt which passes through the crankpin first. If the draw-bolt is removed first, the other bolt will bind and difficulty will be experienced in removal.

The connecting rod brasses must be clipped on to the crankpin when the connecting rod is removed and the coupling rods are left in position.

If the lifting links, the reversing shaft or reach rod is broken, both dieblocks should be secured in the desired position in the expansion links with the wooden quadrant blocks which are provided for this purpose. Proceed, controlling the speed with the regulator. Should the lifting links or lifting arm break, the dieblock on the affected side should be blocked as required in the expansion link. When one or both dieblocks are blocked in this manner the locomotive cannot be reversed without first reversing the dieblocks. In fore gear, with direct motion locomotives, the short blocks are inserted below the dieblock and the longer ones above. To reverse the locomotive, reverse the blocks.

MOTION-GEAR FAILURES

When a motion failure occurs, it is usually necessary to centre the valve on the damaged side, and in some cases the crosshead requires blocking. When a valve is centred, both cylinder cocks must be blocked open, in order to release any pressure that may possibly build up in the cylinders. As a rule, there is no reason why the piston and crosshead should not run under these conditions, but if this practice is adopted, care should be exercised to ensure that the cylinder is well lubricated, particularly if the locomotive is equipped with a hydrostatic lubricator. A liberal supply of cylinder oil should be injected into the cylinder through the sight holes or the relief-valve opening. It is generally desirable to take down the connecting rod at the first available opportunity, but time should not be wasted by so doing unless the nature of the failure demands such action.

CENTRING VALVES

The valve should be placed in mid-position covering both steam ports, and the valve spindle secured by means of the set screw which screws into the valve guide, or by using other equipment that may be provided for the purpose according to the type of valves fitted. On locomotives fitted with piston valves, if the valve spindle is broken, the valve may be centred by using the set screw provided for the purpose (which screws into the front steam chest cover) and by securing the spindle in the usual way.

The setting of a centred valve may be checked by giving the locomotive a little steam and noting whether steam blows from either of the cylinder cocks. Care should be exercised during this test, particularly if the connecting rod has been taken down. As soon as the valve is correctly located in its mid-position the valve spindle should be secured.

With Walschaerts gear, the union link, eccentric rod, and lifting links require to be taken down when the valve is centred, but in some cases, depending upon the type of failure, removal of the radius rod and union link is sufficient.

BLOCKING CROSSHEAD

The crosshead should be blocked at the front end of the stroke for Ab, locomotives, because the crosshead will not clear the crank pin in all positions.

If the valve cannot be centred, the crosshead should be blocked at the end where the steam port is closed, and the cylinder cock at that end should be blocked in the open position to relieve any pressure that may build up in the cylinders.

Thus, with inside-admission valves, the crosshead should be blocked at the opposite end to that at which the valve is secured and with outside admission valves the crosshead should be blocked at the same end as that at which the valve is secured. However, in certain cases such as that mentioned above where the crosshead will not clear the crank pin in all positions, the valve has to be secured in such a way that the front port is open, and great care must be taken in blocking the crosshead to ensure that the clamps will not carry away when the steam load acts on the piston.

On locomotives equipped with inside-admission piston valves, the front port is open when the valve is at the front end of the stroke; the back port opens when the valve reaches the rear end of the travel.

On locomotives fitted with Walschaerts valve gear and inside-admission valves, the radius rod is attached to the upper end of the lap-and-lead rod and the valve-stem connection is beneath it.

SLIDE-BAR BOLTS BROKEN

When bolts are broken and slide bars have to be secured with the clips supplied for the purpose, care must be taken to see that the clips are placed in a position where they will not foul the lap-and-lead rod on locomotives fitted with Walschaerts or Baker valve gear.

BROKEN VALVE SPINDLE

If the valve spindle is broken outside the valve-spindle guide, the valve should be centred and secured. If a failure of this type occurs on a locomotive equipped with Walschaerts valve gear, it will probably be found that other sections of the valve gear will also be damaged, and the nature of such damage will determine the amount of uncoupling necessary. The broken or defective parts must be removed or secured and the locomotive worked to its destination or to a depot, as the case may be, on the workable side.

If the valve spindle breaks between the gland and the valve-spindle guide and the locomotive is provided with a valve-centring stud on the front end, the broken parts of the valve spindle will require to be left in place so that the valve may be correctly centred.

To ascertain if the valve spindle is broken inside the steam chest, the engine should be placed on the top or bottom quarter, the cylinder cocks opened, and the brake applied. When steam is applied and the lever reversed, under ordinary circumstances there would be a blow of steam from the cylinder cocks alternately, but if the valve spindle is broken inside the steam chest the steam will blow from one cock only.

BROKEN VALVES OR PORT BRIDGES

When the piston-valve head is broken, place the crank on the affected side on the top or bottom quarter, apply a little steam and move the valve backwards and forwards, and then ascertain whether the valve shuts off steam from exhaust or restricts it in any position. If so, the valve should be secured in that position, the piston blocked accordingly, and the locomotive worked on the remaining side, with reduced load if necessary.

A broken port bridge will be indicated by a heavy irregular blow from the exhaust, but with a defect of this type there will be no blow from the exhaust when the valve is in the centre position. If the amount of steam passing through the broken port bridges renders it impossible to work both sides of the engine, the valve rod on the disabled side should be disconnected, the valve secured in the centre position, the cylinder relief cocks opened, and the locomotive worked on one side only.

CYLINDER OR STEAM-CHEST LEAKS

If steam leakages of this nature cannot be quickly remedied and the quantity of steam being emitted is such that the timetable schedule cannot be maintained, arrangements should be made, where practicable, to proceed with a reduced load. It will be found when working under such conditions that the best results are generally forthcoming when the reversing lever is fully extended.

CYLINDER ENDS BLOWN OUT

With defects of this nature the valve should be centred and secured, but there is no necessity to block the crosshead unless further damage, which prevents its free movement, has been sustained. If the piston, piston rods, and the remaining parts of the motion gear are in good order and the locomotive has to run a relatively short distance only, it may be an advantage to utilise the disabled side, particularly if a grade has to be negotiated. However, considerable quantities of steam escape when working under these conditions, and the practice should not be adopted if there is a possibility of the locomotive running short of steam by so doing.

PISTON HEAD BROKEN

The valve must be centred and secured and the crosshead blocked.

PISTON ROD BROKEN

This accident almost invariably results in knocking out the front cylinder cover. The valve should be centred and secured. If the break is close to the crosshead it may not be necessary to block same, but if the broken portion of the piston rod attached to the crosshead does not clear the stuffing box when on the front dead centre the crosshead should be blocked and the connecting rod taken down.

CROSSHEAD SLIPPER BROKEN

If a well oiled piece of hardwood of suitable thickness is used to replace a broken crosshead slipper, the locomotive may run to its destination. On some locomotives the bottom slipper may be placed on top of the crosshead and the hardwood placed on the bottom where the pressure is least. If the locomotive is running tender or bunker leading, the sound slipper should be placed on the bottom and the hardwood on the top. On crossheads with removable sides, these can be loosened and the hardwood gripped between them.

WALSCHAERTS VALVE GEAR BROKEN

If the lap-and-lead rod, radius rod, union link, or expansion link is broken the broken parts should be removed or secured, the valve centred and secured, the eccentric rod removed if required, and the lifting links uncoupled.

If the crank arm or the eccentric rod is broken, it is necessary to remove the broken parts, centre and secure the valve, and uncouple the lifting links. Where the crosshead is liable to foul any of the disconnected gear or where the crank arm has come off the crank pin completely and no gear is available for keeping the connecting-rod big end on the crank pin, the connecting rod should be removed and the crosshead blocked.

CRANK PINS OR SIDE RODS BROKEN

If the driving-crank pin breaks, the eccentric rod and connecting rod on the side concerned, and all coupling rods on both sides, should be taken down, the valve centred and secured, the crosshead blocked, and the lifting link uncoupled on the affected side.

If the trailing crank pin or coupling rod breaks, remove the coupling rod affected and the corresponding coupling rod on the opposite side.

In cases where relief is readily available, both crossheads should be blocked and the locomotive towed home. Otherwise the locomotive should proceed slowly to the nearest siding in order to avoid delay to other trains, care being taken to avoid slipping.

CHOCKING AXLE BOXES IN THE EVENT OF BROKEN SPRINGS AND HANGERS

(refer also to diagrams issued with lesson)

Leading Bogie Chocks

Lift the engine frame by using jacks, or by chocking between the top of the leading driving axle box and the frame and by running that wheel on to the lifting wedge. Lift the bogie frame by jacking or by levering. Then insert chocks in position as shown in the diagrams, run engine off lifting wedge and remove chocks from top of the leading driving axle box.

Trailing Bogie Chocks

Lift the engine frame by the use of jacks, or by chocking between the engine frame and the top of the trailing driving axle box and by running that wheel on to a lifting wedge. Additional lift can be given to the bogie frame by jacking or by levering. Insert chocks in position. Then run the locomotive off the lifting wedge and remove the chocks from the top of the trailing driving axle box.

On Ab class locomotives, before the chocks can be placed in position, the spring will have to be removed. Chock the affected driving axle box and block the equalising beams where necessary, particularly the long compensating beam, which can be secured by driving a side rod brass cotter between the rear end of the bracket and the beam.

Where the rail type of chock is used, as is the case with those Ab class which were converted from Wab class and are located in the South Island, remove the spring and the front spring shackle. Place the chock in position, replace the spring shackle, chock between the bracket and the top of the rear end of the long compensating beam. The locomotive can now be lowered either by running it off the lifting wedge, or by removing the jacks. The small fulcrum plate on top of these axle boxes must be left in position.

When lifting with jacks at the cab end of the locomotive frame, use jacks on both sides of the locomotive. On the good side the jack should be placed in position and operated to take a firm but slight lift. Then jack up the disabled side as required. If a jack is used on the disabled side only, extra weight is transferred to the outside journal of the axle on the good side and will cause the wheel on the disabled side to lift off the rail.

Driving Axle-box Chocks

In the event of a coupled wheel axle-box spring or spring hanger breaking, the engine frame will drop and little, if any, space will be left between the frame and the top of the axle box. Run this wheel on to a lifting wedge to lift the engine frame and, before doing so, if space permits, insert packing on top of the axle box to obtain extra lift. Now insert chocks on top of the remaining compensated coupled wheel axle boxes on that side, move the locomotive off the lifting wedge, and run the next wheel on to it. Insert the chocks on top of the axle box with the broken spring or hanger as shown in the diagrams.

To ensure that oil-lubricated axle boxes can be oiled en route if necessary, remove the axle-box lids, or bend the edge of the lids upwards, before chocking.

Special Precautions to be Observed When Driving Wheels are Lifted Clear of the Rails

When driving wheels are lifted clear of the rails, additional weight is carried by the remaining driving axle boxes. This causes an uneven distribution of weight, which may result in damage to the track. Similarly, the track can be damaged by locomotives suffering from other defects involving the chocking of driving axle boxes. Therefore, in order to avoid delays and to clear the main line, locomotives so involved must be run a minimum distance only to the nearest siding at a speed not exceeding 8 km per hour.

Before the journey is resumed, permission to do so must be obtained from the Locomotive Supervisor, who will instruct as to the speed at which the locomotive may be run.

The above instruction does not apply to bogie axle boxes when they are chocked.

LOCOMOTIVE AXLE BOX OR BRASS BROKEN

The locomotive should be run up on a wedge or lifted, the axle boxes on either side of the one affected packed with axle-box chocks, and the equalising beams blocked when necessary.

BROKEN AXLE-BOX WEDGE BOLT

If an axle-box wedge bolt breaks, a piece of wood should be secured between the bottom of the wedge and the keep plate to prevent the wedge from dropping and allowing the box to knock.

COUPLED AXLE BROKEN

If an axle breaks between the journals, the axle boxes should be packed as high as possible between the keep plate and the bottom of the box and the equalising beams affected blocked level. The locomotive should then be lifted to take the treads of the wheels of the broken axle clear of the rails and the other axle boxes chocked on top to take the weight off the broken axle. If the break occurs in a leading or trailing coupled axle, the side rods affected, as well as the corresponding ones on the opposite side, should be taken down and the locomotive worked carefully to its destination. If, however, it is the driving axle that is broken, all side and connecting rods should be taken down, the crossheads blocked and the locomotive

prepared for towing. If the break occurs between the axle box and the wheel centre and no serious damage has resulted, the axle box on the affected side should be packed in its normal position, and, if necessary, the axle box on the opposite side treated likewise, after which the coupling rods affected should be removed from both sides and the locomotive moved under its own steam. Even if it is the driving axle that is broken in this manner, the locomotive may still be moved under its own steam with the connecting rod up on the side not affected.

Running a locomotive with one wheel of an axle removed can be done only if the affected axle is fitted with collars on the inside of the axle boxes. If not fitted with collars, the wheel and axle must either be removed altogether, or packed up clear of the rails and secured in such a manner that it cannot work out of the axle boxes.

It may be necessary to cut out the Westinghouse brake on the engine if a coupled axle is broken.

BOGIE AXLE BROKEN-ENGINE

If the axle of a two-wheeled leading or trailing bogie breaks, the locomotive should be lifted at the front or back end, as the case may be, and the leading or trailing axle boxes chocked. The bogie wheels should be packed up, removed, or supported from the framing until the wheels are clear of the rails, and the locomotive moved carefully to the nearest depot.

If an axle of a four-wheeled leading or trailing bogie breaks, the locomotive should be lifted at the front or back end, as the case may be, and the axle boxes of the broken axle packed up between the bottom of the boxes and the keep plates. The nearest pair of driving axle boxes should be chocked, and the affected end of the bogie supported from the framing with chains, or by means of packing between the engine frame and the end of the bogie frame, with the sound axle secured in such a manner that when the locomotive is lowered the wheels of the broken axle are lifted clear of the rails. The locomotive may then be moved carefully to the nearest depot.

BOGIE AXLE BROKEN-TENDER

If the axle of a tender bogie breaks, the tender should be lifted and the axle boxes on the broken axle packed up between the bottom of the boxes and the keep plates. Wooden packing should be secured between the tender frame and the end of the bogie having the sound axle, and the tender lowered. If the packing is the correct thickness, it will lift the wheels of the broken axle clear of the rails and the locomotive can then be moved to the nearest depot. Instead of using the packing it may be more convenient to secure the end of the bogie frame having the broken axle to the tender underframe with chains, so that the disabled wheels are clear of the rails.

TYRES CRACKED OR LOOSE

If a crack in the tyre of a coupled wheel has not opened badly, it may be possible to run cautiously to the nearest siding. A piece of hardwood inserted in the crack will prevent it pounding on the rail. If the tyre opens up, the side rods affected should be taken down, the adjoining axle boxes chocked to take the weight off the affected wheels, and the axle boxes packed between the keep plates and the bottom of the boxes to lift the affected wheels clear of the rails. The locomotive may then be run carefully to the nearest depot.

In the case of a cracked or broken tyre it is necessary to remove the brakeblocks on the affected wheels or in some cases cut out the engine brake altogether.

If it is a tyre of the main driving wheels that is broken, the wheels should be packed clear of the rails, the connecting, coupling, and eccentric rods taken down on both sides, crossheads blocked, valves centred and secured, and the locomotive prepared for towing.

In all cases of a cracked or broken tyre on a coupled wheel, the Westinghouse brake must be cut out on the engine.

If the tyre on a tender or engine bogie wheel is cracked and the tyre is not slack, the locomotive may be run carefully to the nearest siding, provided that a piece of hardwood is inserted in the crack to prevent it from pounding on the rail. If the tyre opens up the affected wheels of the bogie must be lifted clear of the rails, either with chains or by means of packing between the frame and the end of the bogie having the sound axle, and the locomotive run carefully to the nearest depot or siding.

LEADING, TRAILING, OR TENDER AXLE BOX BROKEN

If an axle box of a two-wheeled leading or trailing bogie breaks, the adjoining axle boxes should be packed to take the weight off the affected box, and the wheels secured to the framing, clear of the rails. If an axle box of a leading, trailing, or tender four-wheeled bogie breaks, the end of the bogie having the good boxes should be packed from the frame, so that the weight of the engine or tender, as the case may be, lifts the affected wheels clear of the rails. In both cases, after securing the affected wheels clear of the rails, the locomotive may be run carefully to the nearest depot.

DEFECTIVE FRAME

A locomotive may be run with a broken frame, provided the break shows no sign of opening up when starting or running a train. The train should be started carefully, and the reversing lever kept well out. If the break shows signs of opening up, the engine on the affected side should be uncoupled and the locomotive worked to the nearest depot.

Under no circumstances should a locomotive be allowed to tow another locomotive with a broken frame when the latter has a train attached to it.

AXLE BOXES

INSIDE AXLE BOXES - HOT AXLE BOXES

Inside axle boxes should be examined and cleaned frequently, care being taken to ensure that the trimmings are not too tight in the oil holes and that they are feeding oil properly. If a box is very hot, the trimmings should be drawn and the oil recess filled; the collars of the axles and the cheeks of the boxes should also be well oiled. If the box continues to run hot, water should be applied; and as a last resource, or if water is not available, the adjoining boxes should be packed to relieve the weight on the affected box.

OUTSIDE AXLE BOXES - HOT AXLE BOXES

The packing in outside axle boxes should be examined frequently and kept reasonably free, although it must always make contact with the journal. The doors should also be kept close fitting.

If a box is running hot it should be oiled, and the packing pushed up against the journal. If the box is very hot, the judicious use of water may enable the locomotive to be worked to its destination, but at the first opportunity the box should be repacked and the brass replaced if damaged.

TO ADJUST AXLE-BOX WEDGES

Place the locomotive on a straight level road with the right-hand crank slightly ahead of the top quarter. (The left-hand crank will then be just above the back centre and all wedges can be adjusted in the one operation). Release engine brakes and apply tender hand brake. With the reversing lever in foregear give the engine light steam to pull the axle boxes forward. Screw wedges up tight and slack back about $\frac{1}{8}$ in.

TO COTTER UP CONNECTING-ROD AND SIDE-ROD BRASSES

Always adjust the axle-box wedges first. Place locomotive with cranks on side to be adjusted on front or back dead centre. (The reason for setting the cranks in this position is to ensure that the rods, after adjusting, are the correct length and will pass through the centres without binding).

Slack back all cotters. Start at the centre coupling and adjust brass until it is just free to move sideways on the crank pin. Then adjust all side-rod brasses on the same side similarly. Place the locomotive with the cranks on the opposite side on the front or back dead centre and adjust all brasses on this side as described previously.

A big end can be cottered up in any position, but if the pins are oval the back bottom or top front eighth are the best positions as the pin wear is least in these positions.

Little ends can be cottered in any position and should be taken up snug so that there is little or no sideways movement on test. Do not cotter up too tightly or the brass will be cut.

TEST FOR LEAKY VALVE AND PISTON RINGS

Place the locomotive on a straight level track with the crank pins at the top or bottom eighths (i.e. set crank pins on the right side at either top front or back bottom eighth.) The pins on the left side will then be on the top back or front bottom eighths respectively and the coupling rods will be the same height above rail on both sides. Apply the brakes.

Valves. With reversing lever in mid-position, apply steam.

Left-hand Piston. With reversing lever in fore gear, apply steam.

Right-hand Piston. With reversing lever in back gear, apply steam.

A blow of steam up the blast pipe at any of these tests indicates that the rings of the part under test at the time are defective.

TEST FOR SLACK AXLE-BOXES, BRASSES ETC.

Place the side to be tested on the top quarter. Apply tender brakes and release engine brakes (block the wheels of tank engines). Apply light steam and move reversing lever backwards and forwards. Slack in side rod brasses, little and big ends, crosshead and axleboxes can be observed.

For broken frame apply engine brakes and admit substantial steam. Move reversing lever back and forth. If the frame is broken this will be disclosed by its movement under steam. A loose crosshead cotter can also be detected during this test.

A loose piston head is best detected when the engine is starting a train. Steam pressure on the piston as it commences its forward stroke forces a loose piston head off the taper, on to the nut, producing an audible metallic knock.

ENGINE DRIVERS CORRESPONDENCE COURSE

Ab CLASS STEAM LOCOMOTIVES

LESSON NO.7

List of Questions

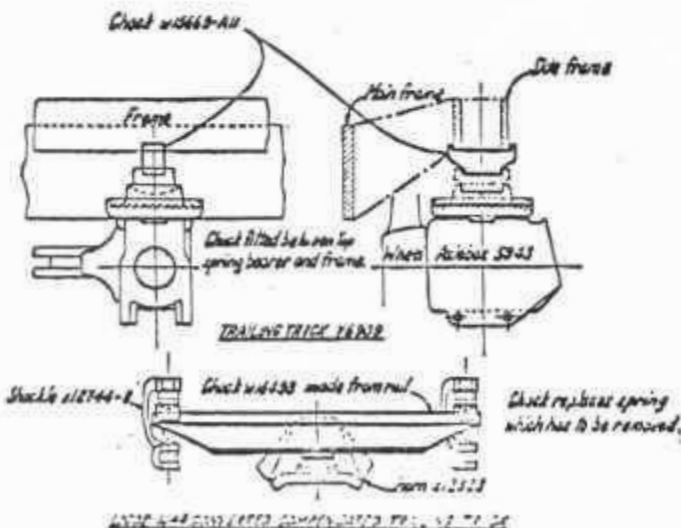
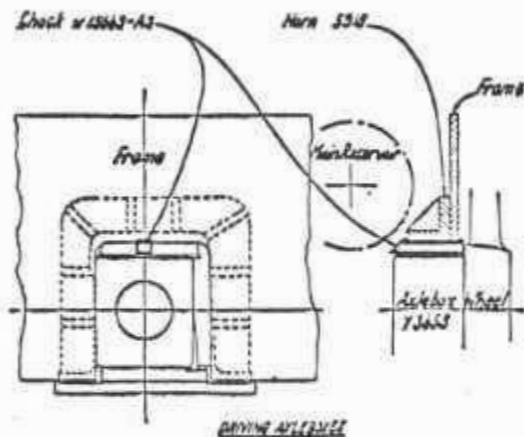
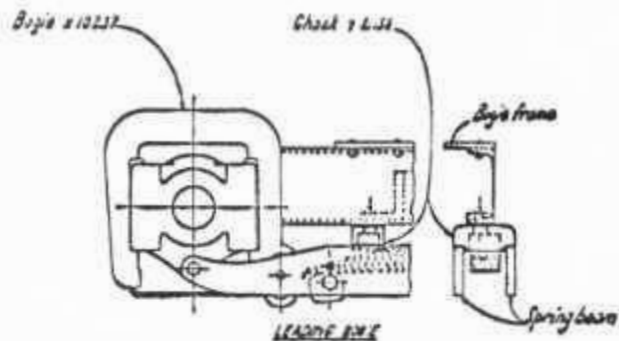
1. If the brick arch collapses what action must be taken?
2. What action must be taken with defective steam pipes?
3. If a safety valve becomes defective what will determine the action to be taken to: (a) Run the locomotive to its destination? (b) Prepare the locomotive for towing?
4. State what action would be required if:-
 - (a) The regulator became uncoupled with the valve open
 - (b) The regulator became uncoupled with the valve closed.
5. If the reversing shaft, reach rod, or lifting links break, what should be done so that the locomotive can be operated?
6. Describe the procedure to be followed when chocking cab bogie axleboxes in the event of a broken spring or spring hanger.
7. Describe the procedure to be followed when chocking the leading bogie.
8. Describe the procedure to be followed when chocking driving wheel axleboxes in the event of a coupled wheel axlebox spring or spring hanger breaking.
9. What special precautions are to be observed when driving wheels have been lifted clear of the rails?
10. If a coupled driving wheel axle is broken describe the procedure to be taken to lift the wheels clear of the rails.
11. State what procedure should be adopted to secure an axlebox wedge if the wedge bolt breaks.
12. If a tender bogie axle broke describe the procedure to be taken to lift the affected wheels clear of the rails.
13. Describe the procedure to be taken in the event of cracked or loose tyres.
14. Describe how you would centre a valve.
15. Describe the procedure required for motion-gear failures.

LESSON NO.7List of Questions

16. Describe how the crosshead should be blocked.
17. Describe the procedure to take down a connecting rod.
18. What is the purpose of side (or coupling rods) and why is it essential that the corresponding rod on the other of the locomotive must be removed if a side rod has to be taken down?
19. What action would you take if a cylinder end was blown out?
20. What action would you take if a crosshead clipper was broken?
21. What action would you take if the crank arm or the eccentric rod is broken?
22. (a) What action would you take if an inside axlebox became overheated?

(b) What action would you take if an outside axlebox became overheated?
23. Describe the action to be taken if a Leading, Trailing, or Tender Axlebox broke.
24. Describe the procedure to adjust the driving wheel axlebox wedges.
25. Describe the procedure to cotter up connecting rod and side rod brasses.
26. State how you would test for leaky valve and piston rings.
27. State how you would test for slack axleboxes, brasses, etc.

CLASS AB LOCOMOTIVES

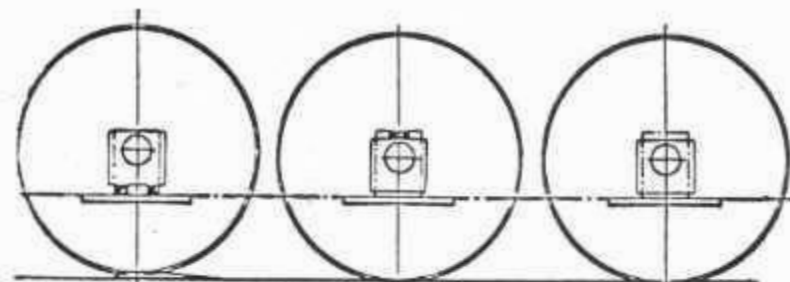
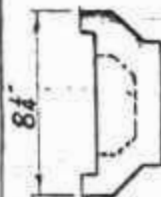


NOTE: 4-48 CONVERTED TO 4-31, 4-31, 4-31, 4-31

METHOD OF LIFTING A PAIR OF COUPLED WHEELS CLEAR OF THE RAILS.

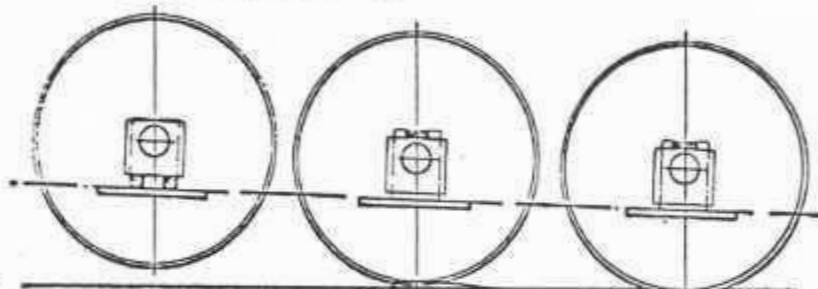
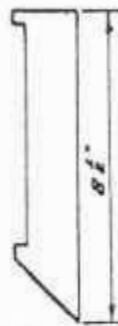
COUPLING RODS AFFECTED MUST BE REMOVED FROM BOTH SIDES OF THE LOCOMOTIVE. CUT OUT THE ENGINE BRAKE, OR REMOVE THE BRAKEBLOCKS FROM THE WHEELS CONCERNED

TRAILING BOGIE



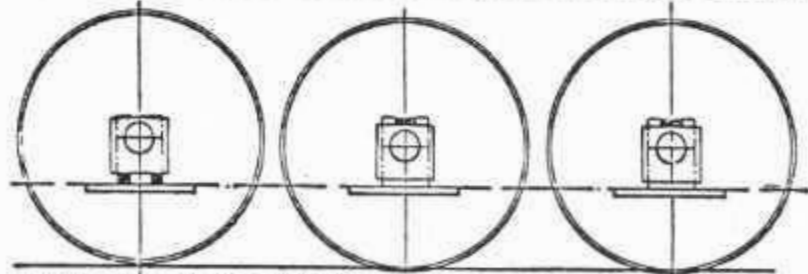
RUN WHEELS TO BE LIFTED ON TO A LIFTING WEDGE. PACK THE AXLEBOX AS HIGH AS POSSIBLE BETWEEN THE KEEP PLATES AND THE BOTTOM OF THE AXLEBOX. CHOCK ON TOP OF THE ADJACENT AXLEBOX.

COUPLED WHEELS



RUN THE AFFECTED WHEEL OFF THE LIFTING WEDGE AND RUN THE ADJACENT WHEEL ON TO THE WEDGE. IT SHOULD NOW BE POSSIBLE TO PACK ON TOP OF ALL OTHER COUPLED AXLEBOXES.

LEADING BOGIE



RUN THE LOCOMOTIVE OFF THE LIFTING WEDGE AND THE WHEEL CONCERNED SHOULD BE CLEAR OF THE RAIL.

LOCO CLASS

AB

BLOCK THE AFFECTED EQUALISING BEAMS LEVEL. REPEAT THE PROCESS ON THE OPPOSITE SIDE OF THE LOCOMOTIVE. SEE THAT ALL AXLEBOXES WITH THE TOP PACKING ARE PROPERLY OILED. AXLEBOX LIDS ARE TO BE REMOVED OR BENT UP AT THE EDGES SO THAT OILING CAN BE DONE EN ROUTE.