LOCOMOTIVE CORRESPONDENCE COURSE - FIREMEN and ENGINEDRIVERS.

LESSON No. 1.

INTRODUCTORY:

This course follows on from the Cleaners and Firemens correspondence course but, naturally, it is more technical and more comprehensive.

Students who have taken the first course will note that three of the original lessons are included in this present series, viz., the locomotive boiler and engine and oil burning equipment and its operations. The questions on the these lessons will be suitably framed to solicit from students a fuller knowledge of the subjects discussed, in uniformity with their wider practical experience. The theme of the locomotive boiler and engine will be elaborated in subsequent lessons.

AIM:

The purpose of the course is to give you a thorough knowledge of the locomotive so that you will be enabled not only to successfully pass your examinations, but also to give you a real interest in the important job you have undertaken. Modern transport developments have entailed the building of larger, more complex, and more efficient units of motive power, and this demands from engine crews a higher standard of technical knowledge so that they may become competent in their operations.

The installation of modern signalling equipment to deal with the ever increasing density of traffic on our main lines and faster and heavier trains also means that locomotive crews should have an intimate knowledge and understanding of the signalling systems in use on our railways.

This aspect of the Enginedrivers responsibilities will be fully covered in the course, and in this connection, students are advised that frequent reference to the Rules and Regulations and Handbook of Instructions will be necessary to successfully deal with the sections dealing with signal and tablet operation.

The lessons will prove useful and interesting if they are given constitent study and a real effort is made by the student to complete them regularly. Students are enjoined to seek information on any technical questions that seem obscure to them, as this is a service that the Training School is pleased to undertake. Such inquiries should be written on separate sheets of paper and maybe included in the lesson envelopes for the sake of convenience. Such inquiries may be sent in by any locomotive member notwithstanding that he might not be taking the course.

HOW TO HANDLE THE LESSONS:

Answers to each set of questions should be written in ink on scrap paper and forwarded for checking to the Supervisor, Staff Training, Wellington. Use the envelope provided with the lesson. On receipt in Wellington, the answers will be checked, corrected where necessary, and returned to you, together with the following lesson. The corrected answers should be kept for reference purposes.

Put your name, address and date at the right hand top corner of the first sheet of answers.

Leave sufficient room at the top of the first page for the "Marks" stamp.

At the beginning of each set of answers write the lesson number.

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The answers must follow each other in the order given in the list of questions.

A space of at least three lines must be left between answers to enable corrections and amendments to be made.

Write all queries on a separate sheet of paper with your name and address and date on the right hand top corner, because all answers to questions are dealt with separately from the lessons.

Where queries are made in connection with checked papers, a separate memorandum must be sent with the lesson concerned.

The questions papers must be attached to the answer.

Endeavour to cultivate neatness of writing and setting out, good spelling should also be aimed at, as this will greatly facilitate accuracy and assist you to be successful.

You should endeavour to complete each lesson in a fortnight so that the whole course may be completed before you sit for your examination.

Write answers in your own words. Do not quote instructions word for word. To copy the answers direct from the book is of little use. Be brief without missing essential points.

Read carefully through the relevant articles in the papers and instruction books and endeavour to make yourself thoroughly conversant with the subjects you are studying.

When students are granted annual leave etc., or are transferred they are requested to advise the Supervisor, Staff Training, Wellington, immediately.

A FEW DO'S AND DONT'S:

Make up your mind that you are going to put your best into your studies. If you are half-hearted about it, don't take up the course. The effort and the expenditure in running the course cannot be justified on those grounds.

Don't let anything prevent you from completing the lessons on due date.

Don't be put off by discouraging remarks from disinterested parties. Remember that the more active and interested you are, and the more you strive to do every job well, the easier it all becomes for everybody, yourself included.

Take every opportunity of attending lectures and instructional classes that are held from time to time by special officers - the Signal Instructor, the Brake Inspector, and the Road Foreman. Remember that the Locomotive Foreman and his assistants are ready and willing to impart their store of knowledge to you at all times. Do not hesitate to approach them when in any difficulty.

Do not expect too much from this Correspondence Course. While it is aimed at giving an adequate theoretical training there is no substitute for practical experience on the road, and no amount of theory will make up for personal deficiencies in the student. He must tackle his job conscientiously, giving close attention to his detailed duties and exercise a wise discretion in meeting difficulties that crop up inevitably in train operation.

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By being restless in his endeavours to acquire all types of information, not only that confined to the operation of the locomotive, but also touching the wider sphere of transporation generally, he will find that locomotive running is something more than the mechanical operation of a large machine, but that it plays a vital part in the complex business of supplying the community with an essential social service. The job is worth doing. It is worth doing well, and your enrolment as a student shows that you are keen to give your best. The course will help you considerably in achieving ambition.

THE ENGINEDRIVERS EXAMINATIONS:

The examination of a fireman for the position of Enginedriver, and the Enginedriver's examination for the position of first class Enginedriver, are fairly comprehensive, covering the following subjects :-

1. Care and operation of the locomotive and its auxiliaries.
2. Knowledge of the locomotive boiler, its construction, operation and maintenance to secure maximum efficiency consistent with economical control.
3. Constructional details of the locomotive and the ability to deal with breakdowns and defects.
4. Methods of lubrication, the making and use of trimmings.
5. Methods of preparing, putting away and general working on the road.
6. Methodical examination of the locomotive and the reporting and booking of mechanical defects.
7. Correct interpretation of all signals and judgement of distances.
8. General knowledge of and the proper application of the Rules and Regulations.
9. The principle and operation of the Westinghouse Automatic, Straight Air, A. 6. E. T. and all allied air brake apparatus on the locomotive tender and vehicles.

SPECIAL FACILITIES:

The attention of students is drawn to the special facilities which are available for gaining specialised knowledge of a practical nature from the Department's experts :-

INSTRUCTION CARS:

Fully equipped instruction cars are located in the North and South Islands and these are under the control of the Brake Inspectors who are only too happy to explain and demonstrate the purpose and constructional details of the wide range of models. Every opportunity should be taken by students to visit these cars when in their district as much useful information will be available.

SIGNAL INSTRUCTORS:

Each Island has its own Signal Instructor who also visits each Locomotive Depot at frequent intervals for the purpose of lecturing and demonstrating models and diagrams covering all phases of railway signalling operations. In addition these officers will shortly be giving demonstrations with coloured film strips of all types of Three Position Automatic Signals.

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Students are urged, therefore, to make the fullest possible use of these facilities created for their particular instruction and guidance.

ROAD FOREMEN:

Road Foremen are available at most depots, and they will be glad to discuss any particular problem with any member sufficiently interested to make enquiries.

DEFINITIONS AND EQUIVALENTS OF TECHNICAL TERMS AND LOCOMOTIVE DATA:

The attached dictionary of terms have been compiled to provide at a glance the meaning of most of the terms used in connection with modern locomotive practice.

DESCRIPTION OF A STEAM LOCOMOTIVE, BOILER, AND ATTACHMENTS:

A N.Z.R. Ab class locomotive is shown in Fig. 1. This drawing should be studied when reading this description and if this is done, the design, construction and use of the different parts will be easier to understand and remember. The Ab class locomotive has been selected for the purpose of illustration because it is simple in design and construction and is being used extensively throughout New Zealand. The drawing does not show a complete arrangement of the locomotive, but is intended merely to show where the principal parts of the engine are, and what they do. It should be borne in mind that other classes of our locomotives may differ in some respects from the Ab class described below. Wherever possible these differences have been mentioned in the description.

The steam locomotive consists of three main parts, (a) the boiler, where the steam is generated, (b) the engine, where the steam is converted into mechanical work for pulling the train along, and (c) the tender, where the coal and water for the boiler are carried.

The boiler is the power house of the locomotive from which the energy generated provides the motive power for the propulsion of the locomotive and ultimately the train.

The student will require to make himself thoroughly familiar with all aspects of this important and essential part of the locomotive as he will be responsible to a large extent for obtaining the most efficient results from the boiler in his capacity as a cleaner and later as a fireman.

This subject will therefore be dealt with fully in this and subsequent lessons.

The diagram issued with Lesson No. 1 will be required for reference in order that the various parts may be quickly identified.

Further diagrams of individual parts or attachments of the locomotive boiler will be supplied in subsequent lessons and these should be carefully filed for future reference.

The locomotive boiler may be divided into five parts, as follows :-

(a) The barrel containing the tubes, which are held in position by the steel tubeplate (5) at the firebox end, and by the steel tubeplate (34) at the smokebox end of the boiler. The tubes 1¾ inches in diameter conduct the products of combustion from the firebox to the smokebox, thus exposing a large amount of heating surface to the surrounding water for evaporating purposes.

(b) The outer wrapper forming the outer casing for the steam and water space surrounding the firebox.

(c) The firebox containing the fire grate, brick arch (64) etc. and providing room for burning the fuel.

(d) Smokebox containing blast pipe (30) main steam pipes (28) superheater (27) etc., and for supporting the funnel (29).

(e) Funnel for conveying the smoke, etc., above the train level and for producing, in conjunction with the blast, a strong draught for the proper combustion of the fuel.

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The boiler shell or barrel is made from flat mild steel plates 1/2 inch thick. These flat plates are rolled into circular courses of the required diameter, and joined by longitudinal seams, which are butted and rivetted together by means of covering plates, inside and outside, secured by double rows of rivets. Two of these courses are then rivetted together to form the barrel of an Ab. boiler (on "K" class locomotives, three courses are used).

The outer wrapper plate is made from one plate forming the top and sides and secured to the foundation ring (65).

The faceplate(1) is fitted into the outer wrapper and forms the rear end of the boiler. This plate is deeply flanged, being pressed into shape by hydraulic pressure, with the flanges turned at a larger radius to give strength and elasticity. The outer wrapper is rivetted to this flanged plate on the two sides and top, the bottom being secured to the foundation ring (65). The various mountings which control the steam to the different parts are fitted to the faceplate, such as the regulator and water gauge glass fittings, etc.

The throatplate is made from mild steel, and is the front of the outer wrapper plate. It is fitted in the form of a saddle to the boiler and rivetted to the foundation ring (59).

The smokebox tubeplate (34) is made from mild steel, flanged all round and rivetted just inside the front end of the boiler barrel. It is drilled to take the superheater flues (10) and boiler tubes(9).

The firebox tubeplate(5) is made from mild steel, flanged all round and rivetted to the sides of the firebox, and holes are drilled in it in exactly the same position as for the smokebox tubeplate to take the superheater flues and boiler tubes.

The foundation ring (59 and 65) extends round the bottom of the firebox and is secured between the inner and outer shells by rivets passing through the two shells and the ring.

The firebox is made from a mild steel plate, the crown sheet bent to form the top and sides, another plate, the backplate shaped to suit the firebox door, forms the back of the box, and the tubeplate the front.

Stays are used in the construction of a locomotive boiler around the firebox, as the circular parts of the boiler can easily withstand the internal pressure, but the flat surfaces around the firebox would immediately bulge were it not for the stays tieing the two surfaces together. Around the back, front and sides of the firebox, the inner and outer plates are held together by stays, some of which are a flexible type of stay, and which permit a certain amount of movement between the two surfaces.

The faceplate is stayed to the top of the outer wrapper by means of palm stays or end braces (6) and the top of the firebox is stayed partly by sling stays (8) and partly by crown stays (7).

The bottom of the firebox is formed by the firegrate, which is made with bars (62) of a suitable shape to admit the air necessary for the burning coal. These bars are placed side by side and legthways with the firebox, the ends being supported by bearer bars fixed across the bottom of the box. These firebars are made in the form of a tapered iron casting, wider at the top edge than the bottom, and cast with facings to keep them a suitable distance apart, so that the air can pass freely between them to the fire. The firegrate inclines downwards towards the tubeplate, the motion of the engine thereby gradually working the fuel forward and assisting in a proper distribution of the fire over the grate area.

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An arch (64) made from firebricks is erected inside the firebox immediately beneath the bottom row of tubes, where a combustion chamber is not provided. It is built in the form of an arch so as to be self-supporting, being erected from side to side of the firebox, the two ends resting on studs.

On the larger locomotives it is common practice to provide a combustion chamber in which the gases from the firebox can commingle before passing on through the tubes, thus bringing about more complete combustion of the fuel. This chamber is as a rule formed as an extension of the interior firebox, to the heating surface of which it adds a fairly considerable area.

The arch, which inclines upwards towards the fire-hole door acts as a baffle and performs a very important function as such in compelling the gases to take a circuitous course through the firebox, thereby giving more time for their proper combination and combustion.

The grate area of Ab locomotive boiler is 33 sq. ft.,and it is only by the use of an intensely strong draught that sufficient fuel can be burned to meet the heavy demand for steam. If unretarded, it will be seen that this strong draught would carry forward the products of the fire before their heat had been given up. These hot gases would escape by the lower rows of tubes and the cold air would be drawn from the firehole door over the top of the fire to the detriment of the tubeplate, tube-ends and steam pressure.

The baffle plate (2) which is fitted in the firehole door, is made to point downwards, so that the entering cold air is directed towards the hot gases and flame passing over the edge of the brick arch, the baffle plate and arch acting in conjunction for the proper mixing of the hot gases and the incoming air.

The ashpan (63) is fixed below the fire grate and forms a receptacle for retaining the ashes that fall from the fire. It is made from mild steel plates, and completely encloses the underside of the firebars. Doors are fitted in the bottom of the ashpan, being operated by levers extending outside the ashpan, and are used to dump the ashes that have collected in the ashpan hoppers.

The heating surface of a locomotive boiler consists of the wet side (outside) area of the firebox, and also the wet side (outside) area of the tubes and flues. Water surrounds the firebox except on the underside. The space between the firebox side plates and the outer wrapper, and which is spanned by stays already referred to, is called the water space, and here steam is very quickly produced as a result of the great heat given off by the white hot fire in the firebox. The hot gases from the fire pass through the tubes and flues on their way to the smokebox and in so doing they transmit the greater part of the heat which they contain to the tubes and flues which are quickly heated through, thus causing the surrounding water to be rapidly converted into steam.

On an Ab locomotive the heating surface of this firebox is 124 sq. ft., and of the tubes and flues, 1024 sq.ft., making a total surface of 1148 sq. ft.

A table setting out the heating surfaces, grate areas, and working pressures of all classes of N.Z.R. locomotives is attached to this lesson for purposes of comparision.

The steam dome (14) is made from a flat mild steel plate, rolled circularly to the required diamoter, which, by means of a suitably shaped base, is rivetted to the boiler barrel, and is enclosed on top by a cover (16). The function of the steam dome is to form a reservoir for the collection of steam well up above the water level of the boiler. It is a well-established fact in engineering that more work can be got out of an engine when "dry" steam (i.e. steam with which water is not mixed) can be obtained, and consequently by taking it at a point as far removed from the boiler barrel as is possible, the risk of water being intermixed with the steam is lessened, although by no means eliminate entirely.

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The regulator valve (15) Fig.3 which governs the admission of steam to the cylinders, is located in the dome for the reasons referred to above. It consists of an iron casting, in which operates an equilibrium or double-beat valve, so called because by virtue of its design, the minimum of effort is required to operate it. It is operated by means of the regulator road (12) which reaches back through the faceplate into the cab.

Steam is also taken from the dome by means of three pipes to provide steam for auxiliary purposes. One pipe leads steam from the dome to the main steam mitre (3) on the top of the boiler in the cab, and thence it is distributed to the various mountings in the cab such as the injectors, blower etc. Another pipe provides steam for the drifting valve, while the third provides steam for the Westinghouse pumps.

The stand pipe (18) is an iron casting located immediately below the regulator valve and in addition to conducting the steam for the regulator, also serves as a falerum point for the regulator road (12). (A fulerum is the support on or against which a lever rests: a prop or support).

The internal steam pipe (19) or dry pipe, as it is sometimes called, is a mild steel tube with brass castings at each end, conveying the steam from the dome to the superheater header (27) in the smoke box. It terminates at the smokebox tubeplate in a spherical ring joint, and it is held in position by the flange of the superheater header.

The Superheater (27) and Fig. 4 consists of a steam collector, when saturated steam is collected, dried and further heated before it is passed to the engine cylinders. This operation is termed superheating the steam.

Generally, the superheater performs two functions :

(a) It acts as a steam drier by evaporating the moisture carried over by steam from the boiler.

(b) The dried steam is heated some 200 degrees to 300 degrees Fahrenheit above its normal temperature at the working pressure and an increase in volume occurs.

By superheating the steam, as this heating process is termed not only is the loss due to the carrying over of moisture avoided but initial condensation in the cylinders is eliminated, or very greatly reduced, and losses due to leakage are also decreased.

In the "M.L.S." type of superheater, the saturated and superheated steam headers are combined in one casting having two separate series of chambers. This casting is positioned horizontally across the upper part of the smokebox. It is provided with a flange for connection to the tube plate so as to communicate with the internal steam pipe and also outlet flanges for the smokebox steam pipes leading to the cylinders.

The casting is divided by internal walls into a number of saturated and superheated steam compartments so that the flow of steam from the regulator to the steam chests can only take place by traversing the superheating elements, which form the only communicating means between the two series of chambers in the header. Thus it is ensured that all the steam is superheated by passing through the elements on its way to the cylinder.

Each superheater element (20) consists of a continuous pipe of solid drawn steel tubing. Four lengths of tubing are connected by three return bends. The inlet and outlet ends are bent towards, and are clamped to steam compartments of the header so that the inlet end communicates with a saturated chamber and the outlet end with a superheated chamber. There are 12 elements, each with an overall length of 54 ft. in an Ab. boiler.

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The elements are located in the superheater flues in the boiler. These flues are of large diameter to accommodate the elements without unduly restricting the area for gas flow, and are arranged in two horizontal rows across the upper part of the boiler. They extend from the smoke box tubeplate to within about 12 inches from the firebox tubeplate.

It will be seen, therefore, that in operation the steam is superheated by the firebox gases which flow through the large superheater flues giving up part of their heat to the steam passing through the elements on its way from the internal pipe to the cylinders the balance of the heat being used in evaporating the water in the boiler. As a result of this transference of heat through the elements the steam is first dried and then superheated, with the result that it has a much higher temperature on reaching the cylinders than when it left the steam dome.

In the N.Z.R. superheater, with which some Ab. locomotives are fitted, the superheater header is made in two parts, one on each side of the smokebox, and the steam taken from the internal pipe divides at a tee-piece at the upper part of the smokebox tubeplate The superheater flues are arranged vertically in two rows on each side of the smokebox, there being six flues on each side. Each header, both R.H. and L.H. has two chambers, saturated and superheated as in the M.L.S. superheater, and the steam, after leaving the tee-piece, passes through the saturated chamber, through the elements and back again to the superheated chamber, whence it passes into a pipe connecting the superheated chambers of both headers, from which it is finally passed to the cylinders.

On the C. K. Ka. Kb. class locomotives there is an important difference in the path followed by the steam through the dome to the atmosphere. These classes of locomotive are fitted with the M.L.S. combined header and regulator, in which the regulator valve is incorporated in the superheater castings. Actually there is a series of poppet valves, actuated by a camshaft from the regulator lever in the cab, and so arranged that they open in sequence accordingl to the amount the regulator lever is opened. In this type of superheater, the steam passes through the superheater elements before passing through the regulator. The path of the steam is thus from the dome to the dry pipe, then through the superheater elements, and finally past the regulator valve before passing to the cylinders. This arrangement has a number of advantages over the old one of having the regulator in the dome, the chief of which are :-

(a) The regulator is as near as possible to the valve chest in the steam line. Under the old system when the regulator is opened, steam has to fill up the internal steam pipe and superheater elements before passing to the steam pipes and so to the valve chests, resulting in a considerable time lag between the opening of the regulator valve and the arrival of the steam in the cylinders. With the new arrangement this time lag is largely eliminated, as the steam passes straight to the steam pipes and valve chests from the regulator, resulting in much easier control of the locomotive, especially for shunting work.

(b) The elements are always full of steam, thus reducing the risk of burning out, which might occur under the old arrangement, through the element becoming dry after the throttle has been closed.

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A disadvantage of this type of regulator is that if a superheater bursts or blows badly, the locomotive will become completely immobilised because it will be necessary to shut down the steam-valve which is fitted to the steam dome. Another fault which sometimes develops is that fragments of scale from the superheater elements or boiler which work their way into the seats of the poppet valves controlled by the camshaft and regulator lever which results in the regulator being difficult to close. The intense heat of the superheated steam on the valve faces also cause some trouble at times, although this to a large extent has been overcome by the use of stainless steel valves.

The smokebox (32) is made from a flat mild steel plate rolled circularly to the required diameter and rivetted to the end of the boiler barrel. If forms and easy passageway in which the combustion gases may turn from a horizontal to a vertical course in leaving the tubes and entering the funnel, and also it serves as a receptacle for solid particles of coal that have been drawn along through the tubes from the firebox.

The smokebox door (33) is hinged to the smokebox front plate, and provides access to the smokebox interior for cleaning the boiler tubes, and for examining, washing out and repairing the various items of equipment that are in the smokebox.

The Blast pipe (30) is an iron casting which stands central with the funnel so that the escaping steam shall be discharged directly through it. The blast pipe at each stroke of the piston, discharges a cone of steam through the funnel. This steam is surrounded by the products of combustion which are withdrawn from the smokebox by the smokebox by the velocity of the steam. This high velocity of exhaust steam, creates a partial vacuum in the smokebox. In an endeavour to fill up this vacuum, air rushes through the firebox and tubes, giving up its oxygen in its passage through the fire, thus creating the strong draught necessary to ensure quick combustion.

It will be seen, therefore, that a leaky or badly fitting smokebox door will seriously impair the effectiveness of this vacuum. In addition it would prevent the rapid passage of air through the firebox which is so necessary for quick combustion, and also because any atmospheric air entering the smokebox direct would cause fresh combustion there by its oxygen combining with the unconsumed carbon which is pulled through the tubes, with the result that the plates would be burnt by the heat so generated.

As there is no exhaust when the locomotive is standing, a blower is provided for blowing up the fire when the exhaust is not available. On the Ab. locomotive, the blower is incorporated in the top of the blast pipe with a series of small holes through the top, the direction of these holes being such that the draught is directed right up the funnel. The cavity in the top of the blast pipe is connected to a blower cock fixed on the outside of the smokebox, which has a connection to the main steam turret in the cab. A connection is incorporated in the blower cock so that steam may be supplied to the blower from another locomotive or from the depot steam supply. This makes for the rapid raising of steam in a locomotive on which the fire has just been started, but on which no steam pressure has been obtained.

The spark arrester (31) is a device fitted in the smokebox whereby the red hot particles of ash are pulverised and so broken up that any ejected to the atmosphere through the funnel are rendered harmless from the fire hazard aspect.

On some locomotives, the spark arrester simply takes the form of a flat perforated plate in the smokebox above the level of the tubes. The cinders strike against this plate, and are either broken, so small that they can do no harm if they pass through, or else fall to the bottom of the smokebox.

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With the increased use of soft coals in recent years, a much improved type of spark arrester has been developed, known as the "Waikato" type spark arrester and so called because it was developed for the safe burning of soft Waikato coals. It is fitted to many types of locomotives. As the products of combustion pass forward through the smokebox from the tubes and flues, and past the spark arrester drum (31) they are given a rotary motion by vanes fixed to the outside of the drum, which results in the heavier particles (ashes, cinders, etc.) being thrown to the outside and collected in a hopper at the bottom of the smokebox. The remainder pass back into the inside of the drum, past the double cowls and up the funnel to the atmosphere. The spark arrester drum is easily removed for cleaning purposes.

Prior to the development of the "Waikato" spark arrester, the "Cyclone" spark arrester was fitted to locomotives, but at the present time, it is fitted only to certain locomotives in the southern district of the South Island. It consists of a vertical cylindrical drum, placed in the smokebox with the bottom attached to the top of the blast pipe and the top attached to the bottom of the funnel. In the smokebox door side of this drum, an opening is provided, which is so shaped that all gases, entering the drum from the smokebox by means of this opening, are led in tangentailly. This portion is assisted by two vanes suitably placed in the opening.

To reach the atmosphere by means of the funnel, all gases, and the sparks which are carried along with the gases, have to pass through the drum, and in sodoing, they are given a rotary motion which causes the heavy cinders, etc., to be deposited at the side of the drum, whence they are cleaned by means of a small hopper at the bottom of the drum.

The funnel (29) is an iron casting, bolted on the smokebox, and is slightly tapered, being larger at the top than at the base, its function being to help to make a draught and to remove the hot combustion gases and cinders to a height which will enable them to clear the train. Due to the large boiler diameter of the more modern locomotives and the restriction imposed by the loading gauge the funnel has become rather short, and in consequence it has been found necessary to increase its effective length by adding an extension or petticoat to the bottom of the funnel within the smokebox.

Safety valves (11) and (17) are provided so that as soon as the boiler pressure reaches its safe working maximum, the valves will lift and allow steam to escape and thus prevent any further increase in the steam pressure.

On Ab. locomotives, three safety valves are fitted, two valves (11) and a point just above the end of the firebox, and a "pop" safety valve (17) fittef to an elbow in the front of the dome. The safety valves(11) and Fig. 5 consist of a spring loaded valve secured in position by a cap and two bolts, which are screwed into the pad on the boiler. A lever on top of each valve, when lifted, enables the steam to be released at a lower pressure than the normal working pressure, while any attempt to increase the pressure at which the valve will blow off, by screwing down the nuts on the holding-down bolts, is prevented by a ferrule placed over each bolt underneath the valve cap. The Ross muffled pop safety valve (17) Fig.6 is also a spring loaded valve, but is designed in such a way that instead of rising gradually as the pressure increases after it has begun to blow off (as do the valves (11) above), it lifts suddenly, with a "pop" and blows off hard for a minute or so until it has reduced the pressure by about 3lb then it reseats itself until the pressure again rises, and so on.

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On the J. Ja. K. Ka. and Kb. class of locomotives, three "pop" valves are used in place of the ordinary safety valves as on the Ab. locomotives. These are not all set at the working pressure of the boiler, as only one is set at boiler pressure, the second one is set at 2lb above the boiler pressure, and the third is set at 4lb above boiler pressure.

Fusible plugs (60) and Fig.7 are plugs made of gunmetal screwed into the crown of the firebox at points about 7 to 8 inches from each end of the firebox. The plugs have a hole through the centre which is filled up with a low temperature fusing metal. Should the crown sheet be left uncovered by reason of a shortage of water, and the plug be exposed to the fire, the fusible metal will melt, and the steam will pass into the firebox, not only giving warning but also damping the fire, thus protecting the crownsheet from damage. These plugs are renewed every three months at the quarterly examination of the boiler, because, with time, the heat and the firebox gases act upon the fusible core, causing deterioration of the fusing metal which would then not melt should the firebox become overheated. A gunmetal bush is first screwed into the crownsheet and then the plug is screwed into the bush, this ensures that, although the hole in the bush may get bigger through renewals, the size of the hole in the sheet remains constant.

Washout plugs (55) (61)(66) are provided to enable accumulated mud and broken pieces of scale to be washed out of the boiler at regular intervals. A hose is inserted in the top plug holes and a strong stream of water washes accumulated waste products down tothe bottom of the barrel and the foundation ring from where it is washed and scraped out through the bottom plug holes. Ab. locomotives are also provided with a mud hole door (58) just above the foundation ring, this providing a larger hole for the removal of the mud and scale.

A blowdown cock is fitted on the outer wrapper and this may be opened when the steam is on, thereby allowing much loose mud and scale to be blown out. The cock is located just above the foundation ring, where all the mud and loose scale will collect. On Ab. locomotives, the blow-down cock is in the form of an ordinary screw down valve. Modern locomotives are fitted with a slide valve which is held steam tight by the boiler pressure itself.

The whistle is secured to the steam dome by an albow (13) and is operated from the cab by a length of cord. It consists of an inverted cylinder of thin metal, with a sharp circular edge, against which a circular sheet of steam is discharged. The force of the escaping steam causes the cylinder to vibrate and give out a musical note, the pitch of which depends on the depth and the diameter of the cylinder. All main line locomotives are equipped with a chime whistle, which has a sound less disagreeable than the one giving only a simple tone, as it produces a pleasing cord of five tones. This effect is produced by the cylinder being divided lengthwise into five compartments, the shortest giving the highest tone.

The fire door on the Ab. locomotives is simply an iron casting which pivots on hinges to one side of the firehole and which is operated by the fireman by hand. It is provided with holes for a damper arrangement. On K. class locomotives the "Franklin" firehole door is fitted. This door which is in two halves, and parts sideways from the centre, is operated by an air cylinder controlled from a treadle lever under the fireman's foot. When in use it is open for a far shorter period than is possible when operating it by hand.

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The steam-heating valve which is under the direct control of the fireman, is located on the left hand side of the cab, and reduces the boiler pressure down to 40lb. per sq. in., which is the pressure in the steam-heating pipe throughout the train. On the older locomotives "Masons" reducing valve is fitted, but on the more modern locomotives Smiths (nottingham) reducing valve is fitted.

Injectors are fitted to all locomotives for the purpose of supplying water to the boiler, and on the "Ab" locomotive are situated one on each side of the inside of the cab. The livestream injector in general use is the Sellars Injector, and is very reliable in operation. All injectors whether live or exhaust stream, derive the energy required to deliver the feed water against the boiler pressure from velocity, momentum and vacuum. The action of the injector, which by the way, will be more fully explained in a subsequent lesson, is due to the high velocity with which a jet of steam strikes the water entering the combining tube, imparting to it its momentum and forming with it during condensation a continous jet of smaller diameter, having sufficient velocity to overcome the pressure of the boiler.

To operate the Sellars Injector: Open wide the boiler steam valve and the tender water supply valve and the water regulating valve on the injector; draw the injector starting lever back a short distance in order to lift the water, and wait for water to appear at the overflow; then carefully draw the starting lever right back and the overflow will cease if the injector has operated correctly. The water regulating valve should then be adjusted to suit the demands of the boiler. It is possible to tell when the injector is working properly by the sound it makes. When the feed water is entering the boiler, the injector will make a fairly high pitched singing sound but if the injector is not functioning correctly, it will be noted that the steam is either blowing back through the overflow valve or if wasting water, the tone of the injector will be much flatter and intermittent than is the case when the injector is working dry.

On some Ab. locomotives, andexhaust steam injector is fitted to the left hand side of the engine intstead of a live steam injector. This exhaust steam injector is a feed water heater which is in principle similar to the ordinary live steam injector, except that it utilizes exhaust steam from the cylinders to heat the feed water and also to force it into the boiler. (A small supply of live steam is also admitted to increase the feed water delivery pressure). It is started by one operation only, namely, the opening of the valve to admit live steam to the injector. The only other manipulation necessary is the adjustment when required, of the water regulator to vary the quantity of feed water supplied to the boiler. It functions as a feed water heater so long as the locomotive is using steam. When the locomotive regulator is closed the injector changes over automatically to live steam operation and it changes bach automatically to exhaust steam operation when the regulator is again opened. The automatic change-over is controlled by steam from an engine cylinder steam pipe, this steam passing to the injector through a small auxiliary steam pipe. When the regulator is opened, steam from the auxiliary steam pipe seats a small auxiliary check valve in the injector and allows exhaust steam to be used; when the regulator is closed the auxiliary check valve is lifted and live steam flows in and operates the injector.

On K. class locomotives, an exhaust steam injector is fitted to the left hand side of the locomotive, and a hot water injector is fitted on the right hand side. The latter injector delivers water at a much higher temperature than the ordinary cold water injector, thereby resulting in a considerable saving in fuel.

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The clack valve Fig.8 is a valve which, as it opens only in the direction of flow of the water from the injector or pump to the boiler, permits the water to pass only in that direction. On the Ab. locomotive, it is situated on each side of the boiler near the smokebox tubeplate and consists of a round box in which the check valves are situated.

On C.J.Ja. K. Ka. Kb. locomotives, the check valve is situated on top of the boiler just in front of the steam dome, and it also performs a further function of heating the water prior to its entry into the boiler.

The water guage glass fittings Fig.9 on the boiler faceplate in the cab are very necessary and important as one the most common causes of boiler explosions is shortage of water. Two sets of fittings are used, so that one acts as a check against the other and as a safeguard should one require repairing or not be working properly. The gauge consists of a straight glass tube, connected at the bottom, by a pad and gland to the faceplate of the boiler, and, at the top, by a short length of copper pipe and a stop cock to the top of the faceplate. The gauge glass and its fittings are so arranged that the top end is in direct communication with the steam space in the boiler, and the bottom end with the water, the bottom end of the glass being fixed above the highest part of the heating surfaces. The gauge glass is a simple and yet effective method of showing the water level, the steam being transparent in the glass, and the water rising in the glass to its own level in the boiler.

The stop cock on top of the boiler faceplate is provided so that in conjunction with the water cock on the gauge glass pad, the gauge glasses may be isolated from the boiler thus enabling a gauge glass to be changed if necessary when the boiler is in steam. Should a gauge glass break, the driver and firemen run a great risk of being scalded by steam, and injured by flying pieces of glass. The first is overcome by a niple, fitted just below the gauge glass, which contains in it a gunmetal ball. When the water rushes through the nipple due to the gauge glass breaking, the ball rises to its seat and cuts off the rush of scalding water. It is retained in this ready position by means of a piece of brass wire placed across the nipple opening. The second is overcome by the fitting of gauge glass protection windows. The glass plates forming the front, back and sides of the protictive windows are specially toughened to withstand the shock of a gauge glass bursting under the highest working pressure.

False readings of the water level will be given should any scale or obstruction be lodged in the holes or pipes leading to the boiler, and on this account the glasses should be blown through frequently. This is done as follows :-

(a) Open try-cock and blow through, see that water returns smartly to glass.
(b) Close steam cock, open water cock and try-cock; see that water blows through freely.
(c) Clase water cock, open steam cock and try-cock see that steam blows through freely.
(d) Repeat test for other glass.
(e) Check water level in both glasses.

The action of the automatic ball valve in shutting off the steam and water, when a break occurs, will be considerably interfered with if the passage leading to the gauge glasses are allowed to become choked with scale or dirt. There should be at least two inches of water showing in the glasses when the boiler is cold.

By watching theglasses, the fireman can fire according to the rate at which the boiler is feeding, and this coupled with a knowledge of the gradients and stops, goes a long way towards economical working.

The steam pressure gauge indicates the pressure of steam in the boiler, and the type in general use in the "Bourdon" gauge in which the pressure is made to straighten more or less a curved, flattened metal tube. The amount of movement is indicated by a pointer travelling about a circular dial graduated to indicate the pressure in pounds per square inch above atmospheric pressure. To prevent the steam taking the temper out of the tube, the steam pipe leading to the gauge is led around the gauge first, the bend of the pipe gradually filling with condensed steam, which prevents live steam from touching the tube.

The boiler clothing or lagging is provided for three reasons; firstly, to prevent the radiation of heat; secondly, for protection against the weather; and lastly, for the sake of appearance. The loss of heat due to radiation would be very great if the locomotive boiler were unclothed, much greater, in fact, than in the case of stationary boilers. The surfaces of stationary boilers are protected somewhat by the settings on which they are placed, but in the case of the locomotive such settings are not available, and the action of the cold air upon the boiler plates when the locomotive is in motion would produce a great loss of heat, resulting in the consumption of a large amount of coal, the heat of which would be entirely wasted. The insulating material applied to the boiler is sheet asbestos about 2 inches thick and curved to suit the boiler barrel, and flat sheets are used to cover the sides of the firebox, the whole of the covering being secured in position by wire.

The steel clothing sheets are placed immediately over the top of the asbestos sheets. As this asbestos would eventually shrink due to heat and vibration, the clothing sheets are held to their proper shape by crinolines, which are placed where the plates join to each other.

The crinolines are made from flat mild steel shaped to two half circles and joined together on a bracket resting on the boiler plates. The depth of the bracket gives the required distance from the boiler plates to the underside of the clothing plates to suit the thickness of lagging. The same principle is followed in clothing the firebox, hexagonal studs being screwed into the outer firebox sides with screw holes drilled and tapped in their outer end. The flat mild steel previously mentioned is fixed to these studs by set screws, the length of the studs defining the thickness of the clothing. The clothing sheets are made from mild steel sheet, rolled to a half circle, and held in position over the crinolines by bands with brackets rivetted on the ends, through which a bolt passes, do screwing the plates up tight, and holding them securely in position. The firebox clothing sheets are held in place by bands passing through brackets secured to the firebox side. The dome cover is made from thin sheet steel and worked by into shape at the bottom to suit the curvature of the boiler barrel.

Attachment of boiler to engine frame:

The smokebox at the front end of the boiler is bolted to the engine framestay which is located between the cylinders.

At the rear end, the firebox is supported on the railing frame of the engine in a manner that allows for the expansion of the boiler when heated. At the front end of the firebox, at each corner, cast steel bearing brackets are bolted to theunderside of the foundation ring and these brackets bear and slide backwards and forwards on similar brackets bolted to the engine framing; the brackets are prevented from sliding sideways. At the rear end of the firebox, each corner is attached to the engine frame by means of bolted steel plates 1/4" thick, these plates being sufficiently flexible to allow for the boiler expansion.

DEFINITIONS AND EQUIVALENTS OF TECHNICAL TERMS AND LOCOMOTIVE DATA.

ABSOLUTE PRESSURE - is reckoned from zero or vacuum, i.e. 14.7lb. below atmospheric pressure.

BOILER OR GAUGE PRESSURE - is that above the pressure of the atmospheric hence boiler pressure plus 14. 7 lb.= absolute pressure.

BACK PRESSURE - is the term generally used to indicate the loss due to the retarding effect of a pressure acting on the exhaust side of the piston. Throttled exhaust either in the pipes or port passages will produce this effect.

CONDUCTION OF HEAT. - is the transmission of heat through any substance.

CLEARANCE - The clearance of a cylinder in the amount of space between the piston and cover, together with the volume of the steam port, when the piston is at the end of its stroke.

CLOSURE - is point at which exhaust edge of a valve closes port.

COMBUSTION - a rapid chemical combination of oxygen of air with any combustible material, producing both heat and light.

COMPRESSION - The increase of pressure of steam confined in one end of a cylinder by the action of the valve in closing the exhaust port while the piston is moving towards that end of the cylinder and thereby diminishing the steam to occupy. To a certain extent, compression is an advantage, because the steam shut up in one end of a cylinder and compressed by the advancing piston acts as an elastic cushion to absorb the shock of the reversal of motion of the reciprocating parts of the locomotive.

CUT-OFF - is point at which edge of a valve closes a port.

CYLINDER - an internally circular body of uniform diameter.

DEAD CENTRE. The crank of an engine is said to be "dead centre" when the piston stands at the extreme end of its travel, either forward or back. At the extreme front position it is on "front dead centre" and at the extreme bach position it is on bach "dedd centre".

EXHAUST CLEARANCE - is distance between exhaust edge of valve and nearest edge of steam port when valve is in mid-position. It shortens expansion, reduces compression, and increases exhaust opening.

EXHAUST LAP - is distance exhaust edge of valve, when in mis-position overlap ports, and is equal to distance valve is displaced from mid-position when release or compression occurs.

EXPANSION (steam) The increase in volume of steam in a cylinder after communication with the steam chest is cut off. This increase in volume is caused by the expansive force possessed by the steam and by reason of which it moves the piston.

FULL-GEAR - is position at which valve gear causes maximum valve travel.

INITIAL PRESSURE - is the pressure of steam in an engine cylinder at the commencement of a stroke.

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INDICATOR - an instrument which may be attached to the engine cylinders and thus indicates in the form of a "diagram" the variations of steam pressure throughout the stroke. The diagram thus obtained is used for computing the amount of work performed by the engine.

INDICATED HORSE POWER (I.H.P.) is the rate at which work done by the steam in the cylinders as shown by the indicator "diagram" it is obtainable by multplying the mean effective pressure (M.E.P.) by the area of the piston by speed of the piston in feet per minute (or, what comes to the same things, twice the number of revolutions by length of the stroke in feet) and divide the product by 33,000; thus we have -

P - M.E.P. in pounds per square inch.
L - Length of stroke in feet.
A - Area of piston in square inches.
N - Number of strokes per minute.

Hence $\frac{P \times L \times A \times N}{}$ divided by 33,000 = I.H.P. developed by the engine.

LAP - is the term used to denote the amount by which the valve overlaps the edges of the ports when in middle position.

LEAD - is the distance that the port is open to steam with the crank on the dead centre. It is the width of steam port opening at the beginning of piston stroke.

MID GEAR - is position at which a valve gear causes minimum valve movement.

MEAN EFFECTIVE PRESSURE - the average pressure acting on a piston during its entire stroke.

ONE HORSE POWER -(H.P.) is a unit of work, and is equal to 33,000 foot pounds of work per minute, i.e. 33,000 lbs. lifted a height of one foot or one pound raised 33,000 feet in one minute.

POINT OF ADMISSION - is that point relative to the stroke at which the valve begins to open for the admission of steam to the cylinder.

PERIOD OF ADMISSION - is that portion of a stroke during which the valve is opening and closing the port, thus admitting steam to the cylinder.

POINT OF CUT-OFF - is that point relative to the stroke at which the valve closes thus cutting off the admission of steam to the cylinder.

PERIOD OF EXPANSION - is that portion of the stroke between the point of cut-off and point of release. During this period the valve covers the ports, and the expanding steam forces the piston forward with a gradual loss of pressure as the cylinder volume increases.

POINT OF RELEASE - is that point relative to the stroke at which the valve opens to exhaust, thus releasing the expanded steam from the cylinder.

PERIOD OF RELEASE - or exhaust, occurs between the point of release and point of compression, during which time the valve is opening and closing to exhaust.

POINT OF COMPRESSION - is that point relative to the stroke at which the valve closes the exhaust, thus usually retaining a certain amount of steam for compression.

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PERIOD OF COMPRESSION - is between the point of compression and point of admission, during which time the retained steam is compressed in the clearance spaces, thus acting as a cushion for-bringing the piston gradually to rest at the end of the stroke.

PISTON - a moveable portion, for separating space in opposite ends of a cylinder.

PISTON CLEARANCE - is distance between a piston, when at either end of its stroke and its striking position against its nearest cylinder head.

PORT - is an opening between steam chest and cylinder, over which a valve is operated.

PORT OPENING - is width of opening to or from a cylinder, caused by a valve when at its extreme position.

PRE-ADMISSION - is point at which steam edge of a valve begins to open a port before piston has completed its stroke.

RADIATION OF HEAT - is said to occur when heat passes from a body into the atmosphere, or from the fire to the firebox.

RELEASE - is point at which exhaust edge of valve begins to open port before piston has completed its stroke.

SATURATED STEAM - steam is said to be saturated when in contact with the water in the boiler, under which conditions a rise of temperature cannot take place without a corresponding rise of pressure.

SUPERHEATED STEAM - steam is said to be superheated when heat has been added after the steam has been removed from contact with the water in the boiler. Under these conditions, by providing for the increase of volume, a rise of temperature may be obtained without a corresponding increase of pressure.

SMOKE - consists of water vapour and gaseousproducts of combustion, coloured with fine particles of carbon.

STEAM - a colourless water vapour, or water changed into a gaseous state by application of heat.

STEAM CHEST - is an enclosed steam chamber in which a valve is operated.

STEAM LAP - is distance steam edge of valve, when in mid position, overlaps ports, and is equal to distance valve is displaced from mid position when admission or cut-off takes place.

TRACTIVE EFFORT - the following formula sets out the method of calculating the tractive effort of a locomotive :-

$$\frac{D/2 \times S \times P}{W}$$

Where D = Diameter of cylinders.
S = Piston Stroke.
P = Boiler Pressure.
and W = Diameter of driving wheel in inches.

A typical example of finding the tractive effort of a "K" class locomotive is given on the following page:-

This class of locomotive has 20 inch by 26 inch cylinders, boiler pressure of 200 lbs., square inch and 4 ft. 6 inches coupled wheels (expressed in inches).

In this country, boiler pressure is based at 80% of the maximum when calculating the tractive effort of the locomotive, thus:

$$\frac{20 \times 20 \times 26 \times 160}{54} = \frac{1664000}{54} = 30,815.$$

Answer - Tractive effort of "K" locomotive 30,815 lbs.

THE BRITISH UNIT OF WORK - is the "foot pound" i.e. one pound raised one foot high.

THE BRITISH THERMAL UNIT - (B.Th.U.) or unit of heat, is the heat required to raise the temperature of one pound of water at about 39.1 degrees F. through 1 degree F.

THE MECHANICAL EQUIVALENT OF THE B.Th.U. - is known as joule's equivalent and is equal to 778 foot pound, or units or work. Heat and mechanical energy are therefore convertible, a definite number of units or work being obtainable from each thermal unit.

TEMPERATURE-is the intensity of heat in bodies thus :

Temperature of

Melting Ice	32 degrees F.
Boiling water at atmoshperic pressure	212 degrees F.
Steam at 50 lbs. absolute pressure ...	281 degrees F.
Steam at 100 lbs. " "	327.9 degrees F.
" " 150 lbs. " "	358.3 degrees F.
" " 200 lbs. " "	381.7 degrees F.

THE BOILING POINT - of a liquid varies with the pressure at which evaporation or vaparization takes place, and is known as the temperature of ebullition thus :-

Temperature of ebullition at -

14.7 lbs. absolute pressure - 212 degrees F.
30 lbs. absolute pressure - 249 degrees F.
60 lbs. absolute pressure - 291 degrees F.
90 lbs. absolute pressure - 319 degrees F.

VALVE - is a sliding member through movement of which admission and exhaust steam to each end of cylinder is controlled.

VALVE GEAR - the mechanism employed for actuating or moving a valve.

VALVE TRAVEL - is extreme movement of valve in either direction at any position of reverse lever.

VALVE EVENTS - are periods during its travel when valve and port edges register.

WIRE DRAWING - is the term generally used to indicate any loss due to reduction or pressure between the boiler and cylinder. This may be caused by throttled steam pipes or ports, or by an insufficient opening of the regulator.

HEATING SURFACES, GRATE AREAS AND WORKING PRESSURES OF N.Z.R. LOCOMOTIVES.

Locomotive Class.	Heating Surface (Sq.ft.)				Grate Area (Sq.ft.)	Working Pressure (As per sq. in.)
	Tubes & Flues.	Firebox.	Total	Elements.		
A	951.5	100	1051.5	168	27.5	255 Compound 190 Simple.
Aa.	1346	113	1459	254	28.3	180
Ab. N.Z.R. 926 M.L.S. 1024	1024	124	1148	183	33	180
B. Narrow Firebox	587.5	97.5	685	125	17.3	175
B, Ba. Wide Firebox.	659	109	768	126	26.4	200
Ba. Narrow Firebox.	581.5	101	682.5	120	16.7	175
Bb.	628	97	725	157	16.8	175
C.	631	93	724	138	24	200
F.	340	45	385	-	9.6	160
[illegible]	1024	151	1175	183	36.5	200
H.	902	74	976	-	17	160
J. Ja.	1319.5	149.5	1469	283	39	200
K, Ka, Kb.	1741	190	1931	482	47.7	200
Q.	1024	124	1148	183	33	180
U.	524.5	85	609.5	110	16	180
Ub.	1230	94	1324	-	16	200
Uc.	524.5	85	609.5	110	16	200
W.	680	60	740	-	12.5	170
Wa.	500	56	556	-	11	170
Wab. M.L.S. 1024 N.Z.R. 926		124	1050	183	33	200
Wb.	780	83	863	-	17.3	170
We.	587.5	97.5	685	125	16.8	200
Wf.	461	74	535	88	14.9	200
Wg.	463	86	549	90	16.9	200
Ww.	463	86	549	90	16.9	180
X.	1048	137	1185	168	37.5	230 Compound 215 Simple

Retain this table for future reference and read in conjuction with the Description of Locomotive Boiler.

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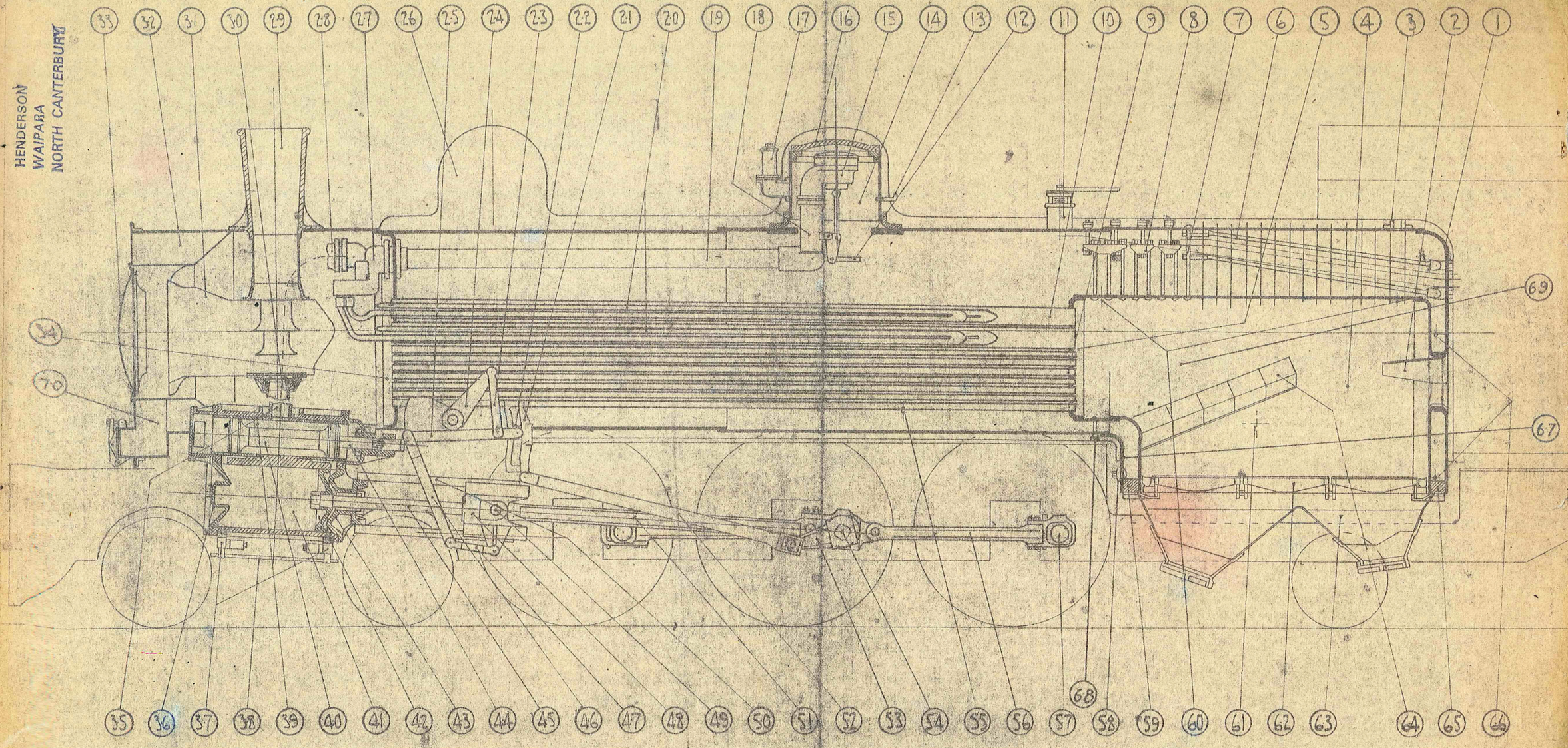
LOCOMOTIVE CORRESPONDENCE COURSE - CLEANERS and FIREMEN.

LESSON 1.

KEY TO FIGURE 1: SECTIONAL DIAGRAM OF Ab. LOCOMOTIVES:

1. Face Plate
2. Baffle Plate
3. Steam Mitre
4. Firebox
5. The Firebox - Steel tube plate.
6. End Braces
7. Crown Stays
8. Sling Stays
9. Boiler Tubes
10. Superheater Flues
11. Safety Valve
12. Regulator Shaft
13. Regulator Rod
14. Steam Dome
15. Regulator Valve
16. Cover
17. Safety Valve
18. Stand Pipe
19. Internal Steam Pipe
20. Superheater Element
21. Expansion Link
22. Die Block
23. Lifting Links
24. Weighbar Shaft
25. Radius Rod
26. Sand Dome
27. Superheater
28. Main Steam Pipes
29. Funnel
30. Blast Pipe
31. Spark Arrester
32. Smokebox
33. Smokebox Door
34. Smokebox Steel Tube Plate
35. Steam Pipe
36. Front Cylinder Cover
37. Cylinder Cock
38. Cylinder Cock Rod
39. Valve Chest
40. Piston Valve
41. Cylinder
42. Piston Head
43. Back Cylinder Cover
44. Valve Spindle
45. Piston Rod
46. Lap and Lead Rod
47. Union Link
48. Crosshead
49. Little End Pin
50. Crosshead Guide Bars
51. Connecting Rods
52. Eccentric Rod
53. Eccentric Crank Arm
54. Crank Pin
55. Washout Plugs
56. Coupling Rods
57. Crank Pins
58. Mud Hole Door
59. Foundation Ring
60. Fusible Plugs
61. Washout Plugs
62. Firegrate Bars
63. Ashpan
64. Brick Arch
65. Foundation Ring
66. Washout Plugs
67. Outer Throat Plate
68. Flamery Stay
69. Combustion Chamber
70. Ash Hopper.

HENDERSON
WAIPARA
NORTH CANTERBURY



SECTIONAL DIAGRAM OF LOCOMOTIVE

FIG. 1.

LOCOMOTIVE CORRESPONDENCE COURSE : FIREMEN AND ENGINEDRIVERS

LESSON NO. 1 LIST OF QUESTIONS :

1. Of what does the heating surfaces of a locomotive boiler consist?

2. Name the various types of spark arresters in use on N.Z.R. locomotives and explain their action.

3. Describe the action of a Ross pop valve

4. What is the purpose of (a) the mud hole door, (b) washout plugs?

5. What is the purpose of the steam heating valve and what is the maximum steam pressure that should be maintained when in use?

6. How is the locomotive boiler attached to the engine frame?

7. What does the term "Back Pressure" mean when used in connection with a steam locomotive?

8. Describe the difference between saturated and superheated steam.

9. What is meant by the term "valve gear"?

10. What is combustion?

11. What special facilities are available for gaining specialised knowledge of a practical nature?

12. If detained at a starting or advanced starting signal what procedure should be adopted?

13. What indications do mechanical shunting signals display?

14. When may shunting outside the main line points be carried out in (a) Tablet areas, (b) Automatic Signalling areas, (c) non tablet or automatic signalling areas.

15. If a train is stopped by accident, failure or obstruction on the line, what action must be taken?

16. If a train is divided on a single or double line what procedure must be adopted?

17. What authority is necessary for a train to return on the wrong line to the signal box in the rear?

18. If the opposite running line is obstructed or nearly obstructed by a disabled train, what must be done?

19. Explain fully the Enginedriver's duty in connection with the receipt of train advices prior to running his train.

20. Under what conditions is it permissible for a locomotive to push a train?