TT

NEW ZEALAND GOVERNMENT RAILWAYS

ENGINEDRIVER'S CORRESPONDENCE COURSE

LESSON 1

This course follows on from the Locomotive Trainees and Locomotive Assistant's course but naturally, it is more technical and more comprehensive.

The purpose of the course is to give you a thorough knowledge of the locomotive so that you will successfully pass your examinations. It will also give you a real interest in the important job you have undertaken. Modern transport developments have entailed the building of larger and more efficient locomotives and this demands from locomotive crews a high standard of technical knowledge so that they may become competent in carrying out their duties.

The installation of modern signalling equipment to deal with the 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.

All aspects of the Enginedriver's responsibilities will be covered in the course. 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 consistent study and an effort is made by the student to complete them regularly. Students should seek information on any technical questions that seem obscure to them, as this is a service that is undertaken. Such inquiries should be written on separate sheets of paper and may be included in the lesson evelope. These enquiries may be sent in by any locomotive member even though he may not be taking the course.

HOW TO HANDLE THE LESSONS :

Answers to each set of questions should be written in ink and forwarded to Wellington for checking. Use the envelope provided with the lesson. The answers will be checked, corrected where necessary, and returned to you, together with the next lesson. The corrected answers should be kept for reference purposes.

Put your name, designation, address and date at the right hand top corner of the first sheet of answers with each lesson, use no book larger than a standard exercise book as any book larger will not fit the envelope when returned with the next lesson.

Leave sufficient room at the top of the first page of each lesson for the "Marks" stamp, at lease two inches.

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

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, designation 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.

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 forward lessons regularly so that the whole course may be completed before you sit your examination.

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

Read each lesson carefully and, where necessary, the instruction books also, in an 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 details immediately.

SOME HINTS :

TAKE EVERY OPPORTUNITY OF ATTENDING LECTURES AND Instruction classes that are held from time to time by the Signal Instructor, the Staff Instructor and the Road Foreman. Remember too, that the Locomotive Supervisor and his assistants are ready and willing to impart their knowledge to you at all times. Do not hesitate to approach them when in any difficulty.

The course is aimed to give you theoretical training that can be combined with your practical experience. You must tackle the course conscientiously and see that your work is forwarded regularly for checking. This is the only way that the full benefit of the course can be obtained. Spasmodic bursts of study are of little use and you are urged, once you enrol, to keep at your work until the course is completed.

On enrolment you will be forwarded the first two lessons. Send in one at a time. This leaves you with one on hand while the other is being checked.

THE ENGINEDRIVER'S EXAMINATIONS :

The examinations of a Locomotive Assistant for the position of Enginedriver, and Enginedriver for the position of First Class Enginedriver cover the following subjects :

... ...

1. Care and operation of the locomotive, its auxiliaries and the protective devices.

2. Knowledge of the locomotive, its construction, operation and maintenance to secure maximum efficiency. Elementary principles of electricity and simple circuits.

3. The ability to deal with breakdowns and defects.

4. Methods of lubrication, water and fuel systems.

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, Rules and Regulations.

8. The principle and operation of the Westinghouse Automatic, Straight Air, A7EL, 6SL and 26L Brakes.

9. Knowledge of the different types of diesel engines.

SPECIAL FACILITIES

The attention of students is drawn to the special facilities which are provided by the Department for gaining knowledge. They are as follows :

INSTRUCTION CARS :

Fully equipped instruction cars are located in the North and South Islands. These cars are under the control of the Staff Instructors (Locomotive) who are only too happy to explain the details of the wide range of models with which the cars are equipped. Every opportunity should be taken by students to visit these cars when in their district to obtain all the information possible.

SIGNAL INSTRUCTOR :

The Signal Instructor visits each locomotive depot at frequent intervals for the purposes of lecturing on all phases of railway signalling. Students are urged, therefore, to make the fullest possible use of these facilities for their instruction and guidance.

ROAD FOREMEN :

Road Foremen are available at most depots, and they will be glad to discuss any problems with members who approach them for guidance.

Throughout this course the word engine refers to the diesel engine itself and the word locomotive refers to the complete vehicle.

... ...

LOCOMOTIVES :

There are several types of locomotives in service but the prime mover in all cases is the diesel engine.

The locomotives in use at present are :

THE DIESEL MECHANICAL

The transmission from the diesel engine on this type is taken via a fluid coupling change speed gearbox and then a final drive gearbox and then to the road wheels.

THE DIESEL HYDRAULIC

The transmission from the diesel engine on this type is taken via a torqueconverter, final drive gearbox and then to the road wheels.

DIESEL ELECTRIC

These locomotives utilise three main types of machines to produce their drawbar-pull: (a) the diesel engine which drives (b) the main generator which converts the mechanical energy from the engine into electrical energy which is supplied to (c) the traction motors. The traction motors reconvert this electrical energy into the rotary motion required to turn the driving wheels.

These types of locomotive will be described more fully in later lessons.

DIESEL ENGINE

As the prime mover in the type of locomotive now in service is the diesel engine the Enginedriver is expected to know how it works and also the function and the operation of the various equipment that is necessary to make the engine function.

The basic principle of a diesel engine is that it uses the expansion of air to do its work. This is obtained by the heating of air within a closed cylinder thus causing the air to expand and create a force which can be used to drive a piston downwards.

The word engine refers to a variety of mechanical devices which work together so as to form a machine that will convert the stored energy of fuel oil into useful work.

In the case of the diesel engine fuel oil is burnt in a confined space called a combustion chamber and the heat so produced causes the air in the combustion chamber to expand. This pressure is then utilised to operate the engine.

MAIN PARTS OF THE ENGINE

The principal moving parts of the engine are enclosed in a frame which is usually formed from two iron castings called the bedplate and the crankcase. The bedplate carries the crankshaft in a number of bearings while the crankcase carries

... ...

the cylinders and pistons. When the crankshaft bearings are carried in the bedplate it is often referred to as a stressed sump. The sump is formed in the bedplate to carry the lubricating oil. Another type of frame is known as the underslung crankshaft design because the crankshaft is carried underneath the crankcase. There is no bedplate as such, but an oil sump or pan encloses the bottom of the crankcase.

Bedplates, crankcases and cylinder blocks are usually castings. For the stressed sump or bedplate and also for the crankcase and cylinder block, a good quality cast iron is the most common material. Other materials such as aluminium are also used when lightness is a prime requirement.

Another method of construction for larger engines is the welded steel frame. The cylinder block and base upon which it sits is fabricated from steel by welding. All frames are fitted with suitable doors or covers to give access to the moving parts inside the frame work, such as connecting rods, etc. These are known as crank case covers. Water channels and passages are also provided in the cylinder block part of the crankcase.

CRANKSHAFT AND BEARINGS

The main crankshaft which is turned by the downward thrust of the pistons and connecting rods turns the reciprocating motion of the piston into a rotary motion. Attached to one end off the crankshaft is a flywheel which stores energy and dampens out the thrust from individual cylinders.

The crankshaft is attached to the machine which it has to drive. It is forged from high duty alloy steel and consists of several throws on one shaft, the throw being the crank. The sides of the crank are called webs and the crank pin is the part that joins the two webs together and forms the bearing journal where the connecting rod can be coupled to.

A drive is taken off one end of the crankshaft for the camshaft. This drive is usually a chain or a gear train. The crankshaft rotating at high speeds must be carefully balanced to eliminate vibration and reduce the loads on the main bearings. On some types of crankshafts balance weights are fitted opposite the crank throws which, by setting up equal and opposite forces, neutralise the centrifugal load on the main bearings. Crankshafts have passages drilled in the journals, webs and crankpins to provide means for pressure lubricating the bearings.

Main bearings usually take the form of Bronze or steel backed lined bushes. On the underslung type of crankshaft, the top half of the bearing is fitted in the housing formed in the crank case and the lower half's cap bolted up to the crankcase. Where the crankshaft is carried in the bedplate, half of each main bearing is in the bedplate and the other half in a cap bolted to the bed These bearings are lined with an anti-friction metal which will stand up to heavy loads but at the same time will wear thus saving the crankshaft from excessive wear.

... ...

CYLINDERS

The cylinder of a diesel engine is really the main part of the whole engine, all other parts being subsidiary and required either to make the work of the cylinder function or to translate the work from the cylinder to some point where it can be used effectively. The cylinder itself acts as a combined air pump and expansion chamber for the combustion gases. The expansion chamber is formed by the walls of the cylinder liner enclosed at the top by the fixed cylinder head and at the bottom by the moving piston. Since the pressure in the cylinder during a large part of the working cycle amounts to several hundred pounds per square inch, special precautions must be taken against gas leakage. Where the cylinder head makes a joint with the cylinder, leakage is prevented by the cylinder head gasket, which is nipped between the top face of the cylinder liner and the underface of the cylinder head. The head is tightened down on the gasket by the nuts on the cylinder block studs. Leakage past the piston is controlled by piston rings. Cylinder blocks may be cast separately or in whatever numbers are required. These may be fitted together on the crankcase to form an engine of the desired number of cylinders. In some cases the cylinder block will contain in one casting, all the cylinders for the engine. In certain types of engines the cylinder block is made up of a welded steel frame and the cylinder liners are fitted into holes in the top and bottom of the frame. This occurs in the two stroke engines. An airbox is formed in the cylinder frame of the two stroke engine.

LINERS

Inside the cylinder block are fitted liners which may be either termed as wet liners, where the outside of the liner is in direct contact with the cooling water, or dry liners which are merely thin sleeves inserted into the ordinary cast cylinder bore, and do not come into direct contact with the cooling water. The cooling water passes through ports and passages in the cylinder block.

On the two stroke engine where the liner is fitted in a welded steel frame the water passages are fitted into the liner and the liner forms the complete cylinder. In this case the cylinder liner is made of cast iron having a water jacket formed by a cored annular space between the outer and inner walls. Inlet airports are also fitted into this type of liner. Special sealing rings are used to prevent water leakage when wet liners are used.

CONNECTING RODS AND BEARINGS

The connecting rod has the function of linking the piston to the crankshaft and translating the reciprocating motion of the former to the rotating motion of the latter. As a result the small end bearing of the rod ~~which~~ encircles the piston pin ~~which~~ and has a rocking motion only, whilst the big end bearing embraces the crankpin which has a complete rotating motion. The small end of the rod is usually in the form of a bored boss known as the "eye" of the rod. This is bushed to form a small end bearing and the "Gudgeon pin" as it is called is passed through it. Owing to the

... ...

shape of the crankshaft it is necessary to split the big end and bolt the two halves together around the shaft. Connecting rods are made of a good quality steel. On two stroke engines the little end is attached to the piston pin which is fitted into a piston pin carrier located inside the piston and is held in by a snap ring. The piston pin fits into a bearing insert inside the carrier and the connecting rod bolts are screwed into the piston pin itself so that on this type of connecting rod there is no eye. Oil to the little end bearings may be forced up by pressure through holes drilled in the centres of the connecting rod or on two stroke engines the internal parts of the piston are lubricated and cooled by oil from a piston cooling pump, the cooling oil being directed through a drilled passage in the piston carrier. This oil cools the piston crown and lubricates the piston pin. Big end bearings consist of split bushes and are similar in design to main bearings. Small end bearings usually take the form of a steel bush lined with an anti-friction metal. On two stroke engines there may be only the top half of the piston pin with a bearing.

PISTONS

During the working stroke of a diesel engine, the pressure of the burning gases acts on the top of the piston and transmits the force from the gases via the connecting rod to the crankshaft. The type of pistons mostly in use are called trunk pistons. The trunk piston really combines two parts. The upper part known as the crown and ring belt, is the piston proper and the lower part, kn known as the skirt acts as a guide to keep the piston truly axial in the cylinder bore thus stopping the piston from tipping.

The lower part of the piston must be a good sliding fit in the cylinder and being a loaded bearing must be copiously lubricated with clean oil. On the other hand, the upper part or piston proper must be a gas-tight seal in the cylinder and it must be only sparingly lubricated, as otherwise considerable quantities of lubricating oil would pass into the combustion chamber.

Pistons are generally made of aluminium alloy or cast iron. The pistons are cooled either by splashing oil on the interior of the piston crown or by conduction through the material of the piston to the piston rings and skirt and thence to the cooled cylinder walls. They are also cooled by the intake of fresh air on the induction stroke.

When the piston is at the top end of the stroke the clearance between the top of the piston and the cylinder head is called the combustion chamber. The piston head can be recessed to form a larger chamber. On some types of diesel engines the combustion chamber is formed in the head separate from the cylinder.

GUDGEON PINS

The gudgeon pin, sometimes referred to as the piston pin forms a hinged connection between the piston and the upper or small end of the connecting rod. The gudgeon pin is located in bosses formed in the inner walls of the piston skirt. These pins are

... ...

usually made from a case hardened nickel steel. They are usually held in by circlips and the pin itself is often hollow. On two stroke diesel engines the gudgeon pin is fitted into a piston pin carrier which fits inside the piston.

PISTON RINGS

No matter how good a fit the piston may be in the cylinder, or how its expansion is controlled to maintain the clearance at a minimum, there must nevertheless remain some clearance. Unless this clearance be sealed, power will be lost by the gases escaping and the flame from the combustion passing over the walls of the piston will cause them to overheat, destroying the lubricant and causing seizure. Furthermore the diesel engine relies on its compression for firing the injected fuel so that any leakage will cause a loss of compression which will make an engine very difficult to start.

To overcome this leakage the clearance between the ring lands of the piston and the cylinder walls is sealed by piston rings. These are fitted in grooves round the piston. Those fitted near the top of the piston are called compression rings. These rings are designed to spring outwards against the walls of the cylinder and to be as close a fit, top and bottom, as is practical in the grooves in the piston. They must however have a certain amount of clearance in the grooves to ensure freedom of action. A small gap is left in the piston ring to allow for expansion. They are usually made of a special form of cast iron.

With the trunk type of piston the piston is oiled by splash from the oil thrown off the crankshaft and connecting rod. The skirt of the piston requires copious lubrication but the oil to the rings must be limited in order to reduce the amount of oil passing up to the combustion chamber where it would be burned and wasted. To prevent this, oil control or scraper rings are fitted to the piston.

They are located just above the gudgeon pin below the bottom compression ring or placed at the bottom of the piston round the skirt. The purpose of these rings is to scrape the excessive oil away from the walls of the cylinder thus stopping it from passing up to the compression rings.

CYLINDER HEADS

These are made in several different forms and can be cast as individual castings each one covering each cylinder bore, or cast in groups of two, three or more. They serve the purpose of sealing the open end of the cylinder and usually contain the valves, fuel nozzles, and sometimes the combustion chamber. The underface of the head, being exposed to the gases is subject to intense heat. To overcome this the cylinder head can be made into a hollow box casting cooled by water circulated through its hollow interior or be cast with cored water passages through it to circulate the water. The ports and passages for the inlet and exhaust valves are embodied in the cylinder head castings. A decompression or relief valve is fitted through the cylinder head to enable the compression to be broken or a test to be made for

... ...

liquid accumulation in the cylinder. Suitable openings are made in the head where exhaust and water manifolds can be connected.

VALVES

The function of the valves in a diesel engine is to uncover and then seal, at the correct times, the openings to the cylinder for admission of the induction air and the discharge of the exhaust gases. It is important that when fully opened they should allow the air and gases to flow freely through the ports and when closed they should make a perfectly gas-tight seal. The most common type of valve used is called the mushroom or poppet valve. These are made either with a flat face or a recessed face. The upper faces of the valves are ground to fit into the seats made in the cylinder head faces. The valves also are subject to intense heat but are cooled by the action of allowing air to pass over the faces of the valves at the beginning of the induction stroke. Heat also is dissipated mainly by direct conduction through the seat surface into the bottom plate of the cylinder head. It can be seen by this that the cylinder head must be well cooled in the vicinity of the seats and valve guides. Valves are made from steel alloy, and are named "Inlet" and "Exhaust" valves.

VALVE SPRINGS

Mushroom valves are mechanically opened but are returned to their seats by springs. Two springs, one inside the other are often used for valve closing purposes. The springs fit over the valve stem and at the cylinder head end, the springs about on the cylinder head casting or the valve guide or in some cases on washers round the valve guide. At the outer end they press on a valve collar. In most engines this collar is turned with a taper bore to receive the two halves of a split cone called "collets". These half cones are bored to a smaller diameter than the valve stem proper and the stem is reduced in diameter locally to be gripped by them. This arrangement is such that the pressure of the valve spring forces the conical collar on to the split cones making them grip tightly on the valve stem thus holding the valve firmly on its seat. There are several other ways of securing the valve springs. Valve springs are made from spring steel.

VALVE GUIDES

These are inserted in the cylinder head and are provided to keep the valve operating in a certain direction. The guides themselves are made from cast iron and are replaceable. The stem of the valve fits through the guide and must be a good fit. Lubrication of the stem and the guide is carried out at a reduced pressure from the oil system. Oil is allowed to trickle over the top of the valve spring and thus work down the valve stem.

VALVE OPERATION

Poppet valves are almost invariably operated by some type of cam. A cam is a smooth projection on one side of the axis of a spindle or shaft; as the shaft rotates anything

... ...

resting on the cam turns the rotary motion into reciprocating motion. From the cam, motion is transmitted to the valve through some form of follower such as a tappet, a push rod and rocker assembly.

Where push rods are employed, they are generally hollow tubes fitted with ball ends which operate in ballcups in the tappets on one end and the valve rocker assembly at the other end. At some point of the mechanism provision is made for adjusting the valve clearance. On some types of engines hydraulic lash adjusters are fitted which will take up excessive valve clearance automatically.

CAMSHAFTS

On multi-cylinder engines the cams are usually formed on a long shaft known as a camshaft running the length of the engine. There is generally one cam for each valve but when there are two inlet or two exhaust valves per cylinder both valves performing the same function may be operated from the one cam. The camshaft may be located almost anywhere on the engine from the crankshaft level to the cylinder head level. When the camshaft is located on the cylinder head it is known as an overhead camshaft, and the cams can operate onto the valve rocker lever. If the camshaft is located at a lower level push rods will be necessary to operate the valve rocker lever. The camshaft is driven from the main crankshaft and depending on the type of engine operates at either half engine speed for four stroke engines and at engine speed for a two stroke engine. The camshaft generally runs in bearings fitted either on to the cylinder block or on the cylinder heads and the shaft itself is usually made from a case hardened steel. The bearings are oiled from the engine lubricating system.

CAMSHAFT DRIVES

The camshaft is driven from the main crankshaft and may be driven either by gear wheels or by timing chain. When a timing chain is used a chain wheel is fitted to the crankshaft and a tensioning device is used to adjust the chain to the correct tension. Both these types are oiled from the engine lubricating system. It should be noted that the cams are set at different angles on the camshaft so that they open and close the necessary valves in the correct sequence. The timing of the valves is dependent on the camshaft drive which is designed so that the correct speed is given to the camshaft.

This covers most parts of a diesel engine and we shall now learn how an engine fires and what a full working cycle means.

HOW THE DIESEL ENGINE FIRES

In a diesel engine there is no such thing as a spark plug to give a spark to ignite the fuel although on some types of diesels in service a glow plug is used. The glow plug is only for heating the air in a combustion chamber when starting the engine.

... .

The fuel in a diesel engine is ignited by compressing air in the cylinder by the action of the piston moving upwards. When air is compressed its temperature rises to such a degree that if fuel oil is injected into it in the form of a fine spray it will ignite and commence to burn. The burning of the fuel causes the air to expand rapidly and this forces the piston downwards thus turning the crankshaft. The fuel will continue burning while the piston moves down, until all the oxygen has been used. Up to this point the pressure on top of the piston will remain constant but as no more heat can be generated the pressure drops off until the piston reaches the bottom of its stroke and the pressure is released.

ENGINES

There are different types of diesel engines in service depending on the arrangement and the number of cylinders. When the cylinders are mounted vertically in a straight line they are known as vertically-in-line engines. When the cylinders are arranged in the form of a V they are known as V8 or V12 depending on the number of cylinders.

CYCLE OF OPERATIONS

It stands to reason that all cylinders do not fire at the same time as this would give a very uneven performance. To overcome this the cranks are fitted at different angles on the crank shaft and each cylinder fires when the piston for each cylinder reaches the top of its stroke. As each piston reaches the top of its stroke at a different time there are always one or two pistons being forced down giving a turning force to the crankshaft at all times. This gives the engine an even and balanced performance.

In order to obtain this the correct cycle of events must take place in each cylinder in the correct order and this will now be explained.

FOUR STROKE ENGINE

In this type of engine the cycle of operations is repeated once in every two revolutions. There are, accordingly two revolutions of the crankshaft during which air is taken into the cylinder and compressed fuel burnt, expanded, and exhausted and the mechanism must be arranged so that the various parts connected with these operations work at half engine speed as follows :

INTAKE

Just before the piston reaches top dead centre the camshaft which turns at half engine speed opens the inlet valve and, as the piston passes top dead centre and moves down, fresh air is taken into the cylinder. The exhaust valve is closed.

... ...

COMPRESSION

As the piston reaches bottom dead centre the camshaft allows the inlet valve to close and the exhaust valve remains closed. The piston moves up and compresses the air in the cylinder causing a rise in temperature, and at about top dead centre the fuel pump which also works at half engine speed operates to allow fuel to be injected into the cylinder in the form of a fine spray. This fuel ignites and causes combustion which forces the piston downward.

POWER STROKE

All valves are closed and the pressure on the piston caused by the burning fuel forces the piston down which in turn causes the crankshaft to rotate.

EXHAUST

Just before the piston reaches bottom dead centre the camshaft causes the exhaust valve to open and as the piston then moves upward the exhaust gases are exhausted from the cylinder. Before the piston reaches the top the inlet valve opens while the exhaust valve is still open and alows cool, fresh air to enter and clear out the exhause gases and at the same time cool the piston crown, valve faces and the combustion chamber. When the piston reaches top dead centre the exhaust valve closes and the same cycle of events is repeated.

TWO STROKE ENGINE

In the two stroke cycle engine the cycle of operations is repeated each revolution of the crankshaft that is to say, once in each revolution of the crankshaft air must be taken into the cylinder, be compressed, fuel injected, burnt, expanded and exhausted. The mechanism of the engine must accordingly be arranged so that the various parts connected with these operations work at engine speed. The two stroke engines on our services are fitted with exhaust valves operated by the camshaft but instead of inlet valves they have inlet ports fitted in the cylinder walls which the piston opens and closes as it moves up and down during its stroke. In this case air boxes are fitted around the cylinder walls to supply fresh air to the cylinder.

The cyle of events is as follows :

Inlet

When the piston is near the bottom of its stroke the piston uncovers ports in the cylinder walls allowing fresh air to enter the cylinder, clearing out the exhaust gases via open exhaust valves and cooling the piston and cylinder walls.

... ...

COMPRESSION

When the piston moves up the camshaft allows the exhaust valves to close and just after they have closed the piston closes the inlet ports in the cylinder walls trapping fresh air in the cylinder. This air is then compressed by the piston and when the piston reaches top dead centre fuel is injected and burns forcing the piston down.

POWER STROKE

All valves and ports are closed and pressure on the piston caused by the burning fuel forces the piston down which in turn causes the crankshaft to rotate.

EXHAUST

When the piston nears the bottom of its stroke the camshaft causes the exhaust valves to open and at the same time the piston uncovers the inlet ports in the cylinder walls allowing fresh air to enter from the air box and the same cycle of events is repeated.

DECOMPRESSION OR RELIEF VALVES

These are located near the top of each cylinder and pass down through the head.

Their purpose is to open a vent connecting the cylinder space above the piston to the atmosphere.

When open they break compression and allow an engine to be manually barred over to check for any excessive fluid in the cylinders. This must be done after an engine has been stopped for 12 hours or more.

LIST OF QUESTIONS

1. Give a description of a main crankshaft in a diesel engine and state its purpose.
2. What is the difference between a wet liner and a dry liner ?
3. Explain what you know about connecting rods and bearings.
4. How are the pistons cooled ?
5. Name and describe the purpose of the two types of piston rings fitted to a piston.
6. Why is the cylinder head provided and what apparatus does it contain ?
7. Name the two kinds of valves used in a diesel engine and state for what purpose they are provided ?
8. How are the valves operated ?
9. What speed does the camshaft travel at :
   (a) On a four stroke diesel engine
   (b) On a two stroke diesel engine

... ...

LESSON NO.1

LIST OF QUESTIONS

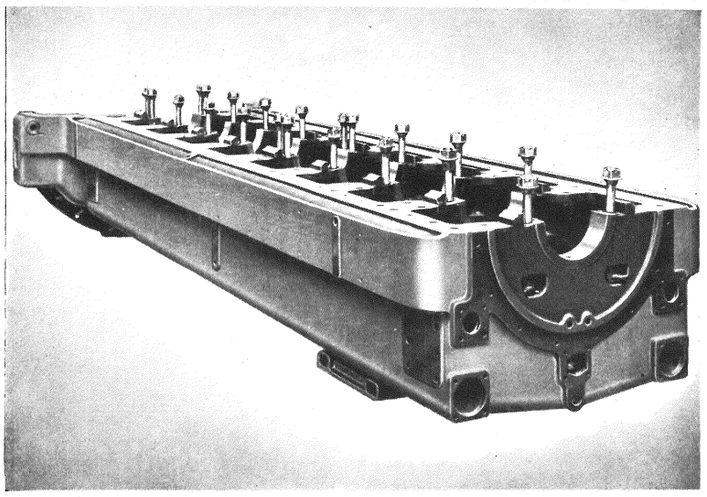
10. Describe fully the piston and valve events of a four stroke engine.

11. Describe fully the piston and valve events of a two stroke engine.

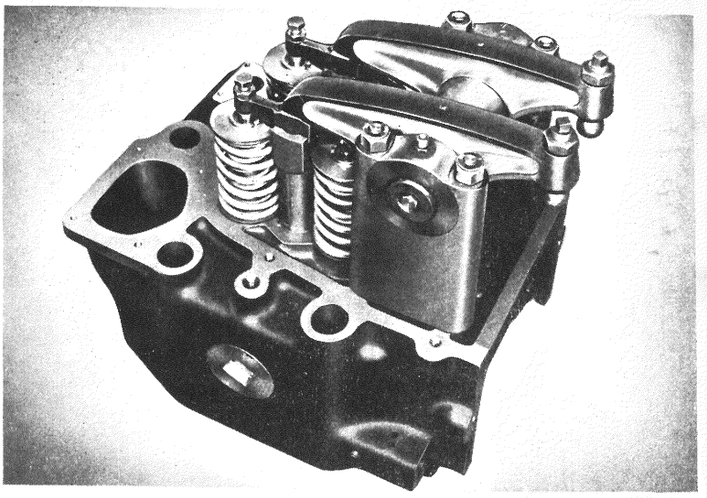
12. What is the purpose of decompression valves or relief valves and when should they be used ?

13. What is meant by :
(a) A six cylinder in line diesel engine
(b) A V type diesel engine

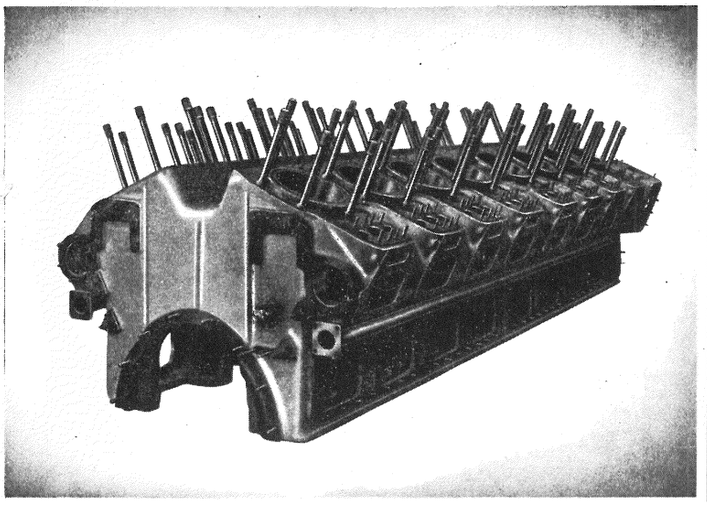
14. How are the camshafts driven ?



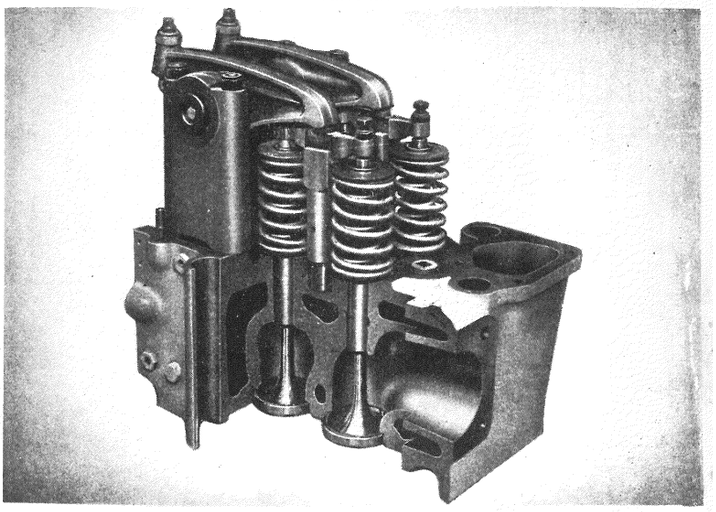
Bedplate



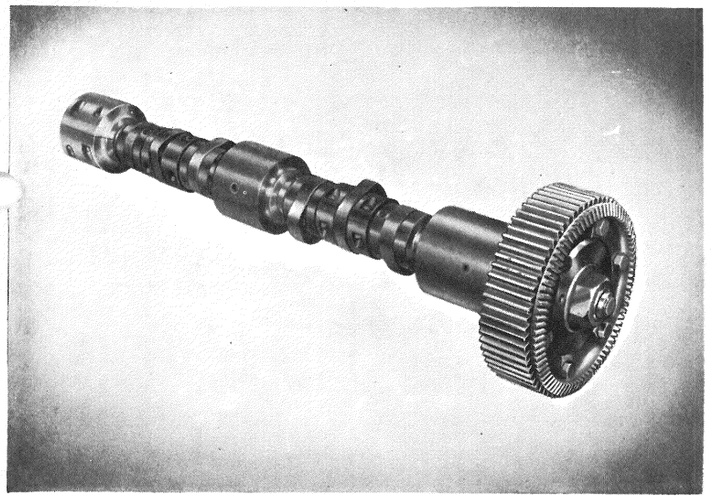
Valve mechanism



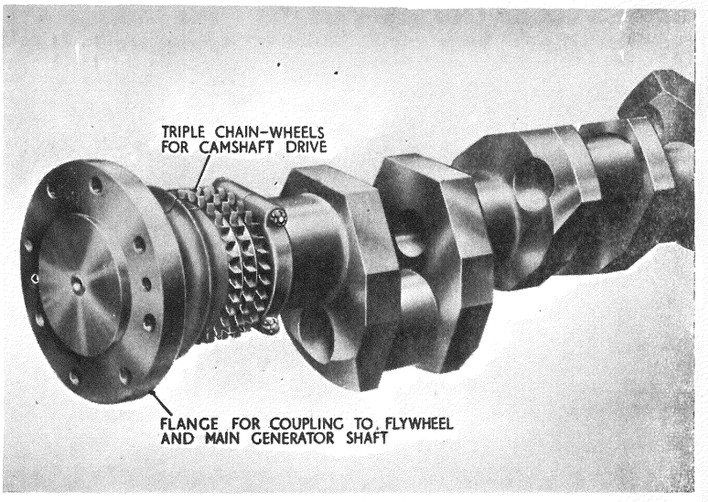
Crankcase



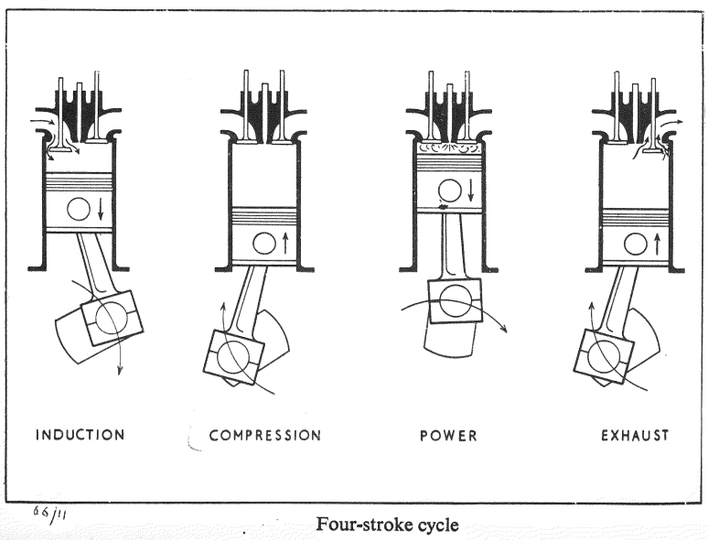
Cylinder head



Camshaft

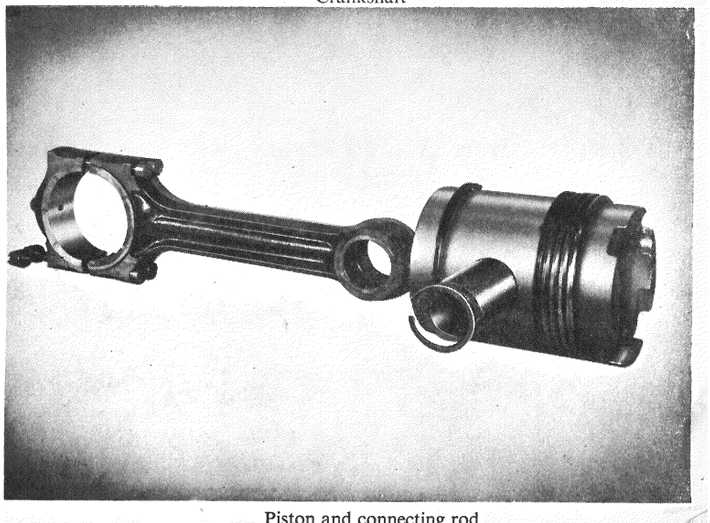


Crankshaft



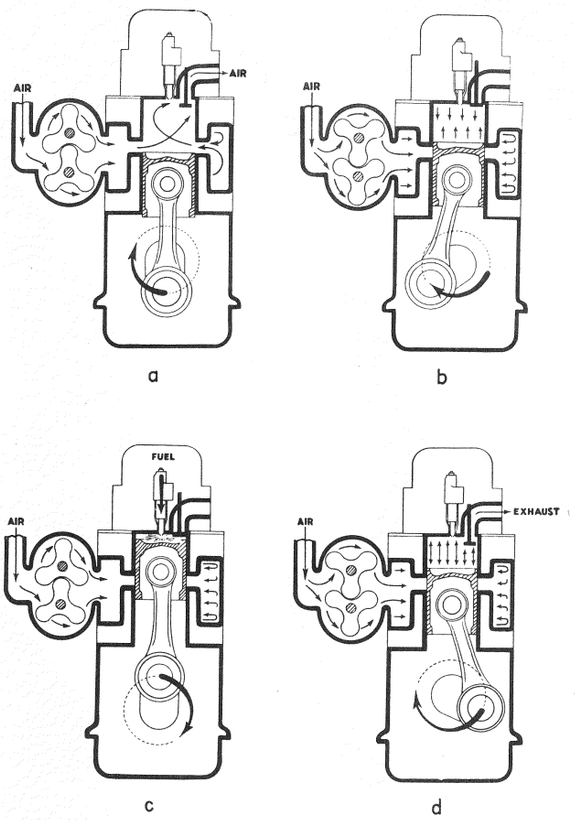
66/11

Four-stroke cycle



Piston and connecting rod

Two Stroke



FOUR-CYCLE

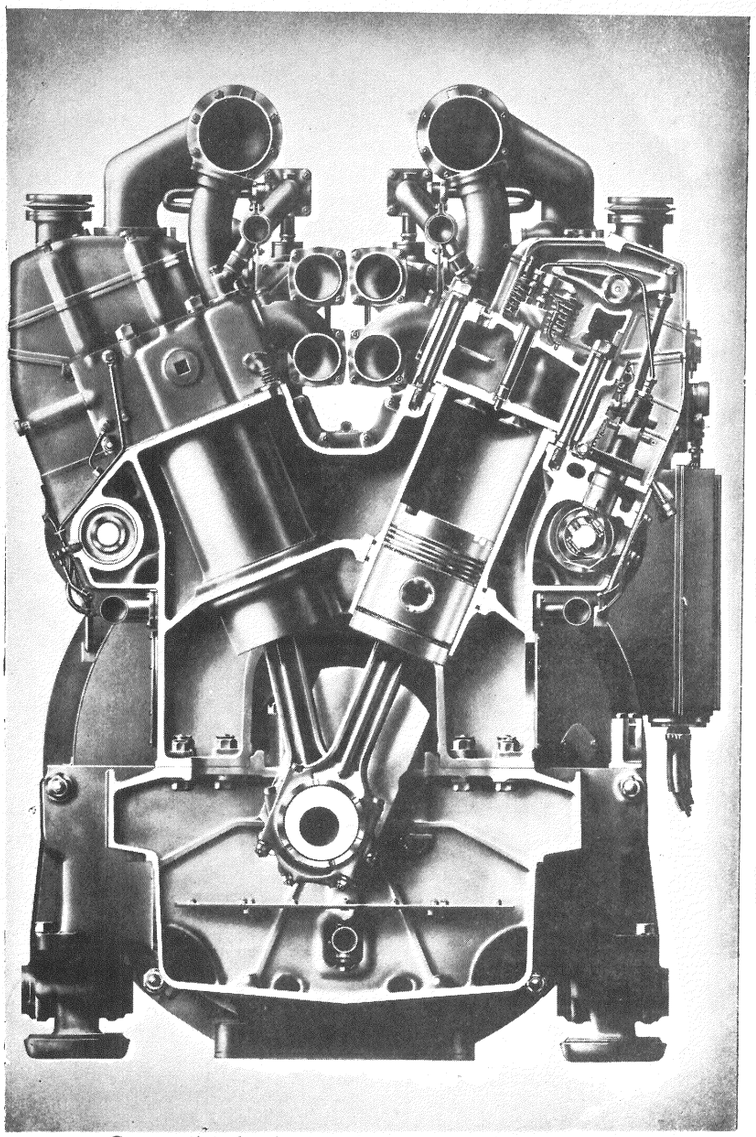
INTAKE STROKE	COMPRESSION STROKE	POWER STROKE	EXHAUST STROKE

TWO REVOLUTIONS OF THE CRANK SHAFT

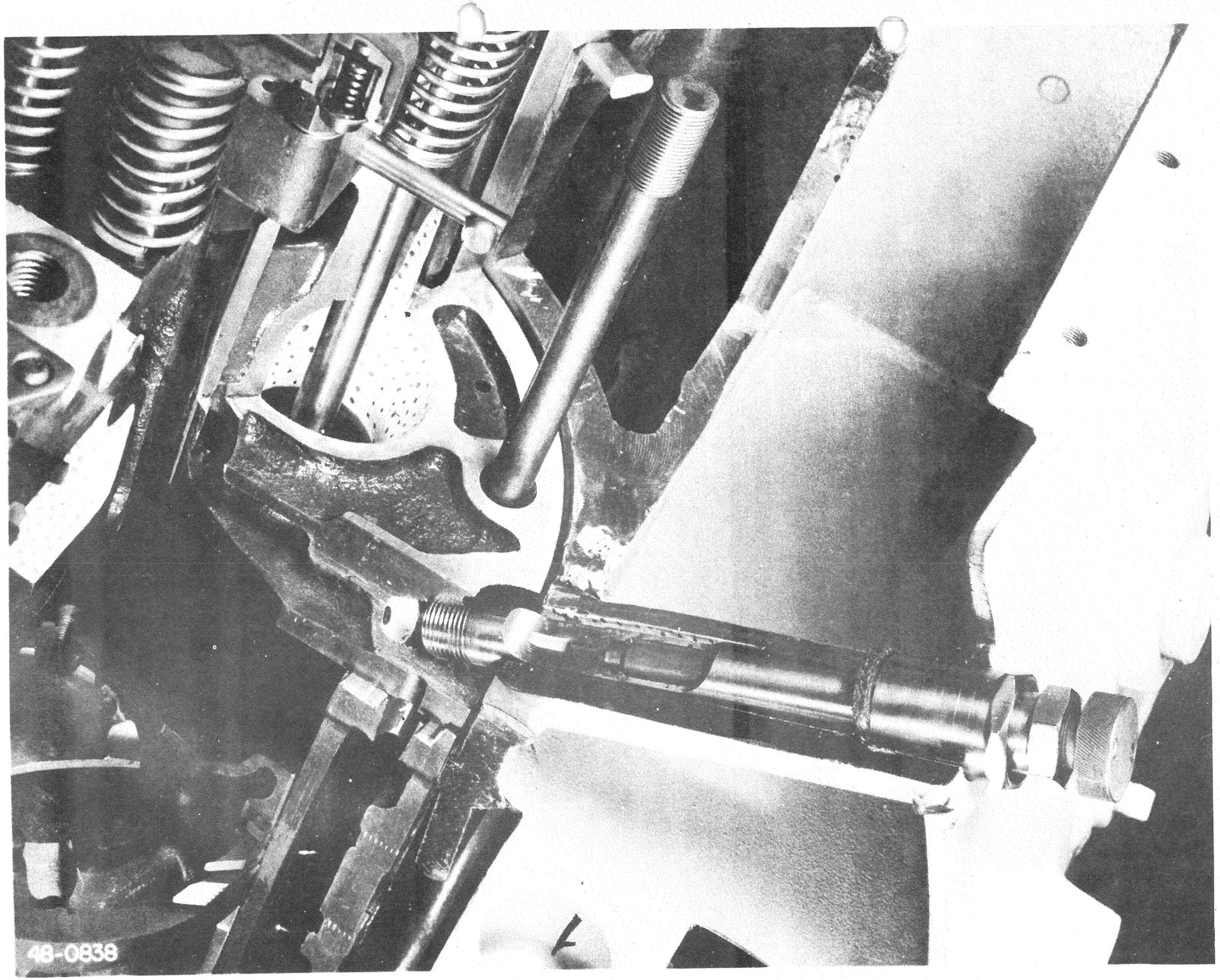
INTAKE	COMPRESSION STROKE	POWER STROKE	EXHAUST	INTAKE	COMPRESSION STROKE	POWER STROKE	EXHAUST

TWO-CYCLE

Cycle Of Events Of Engine

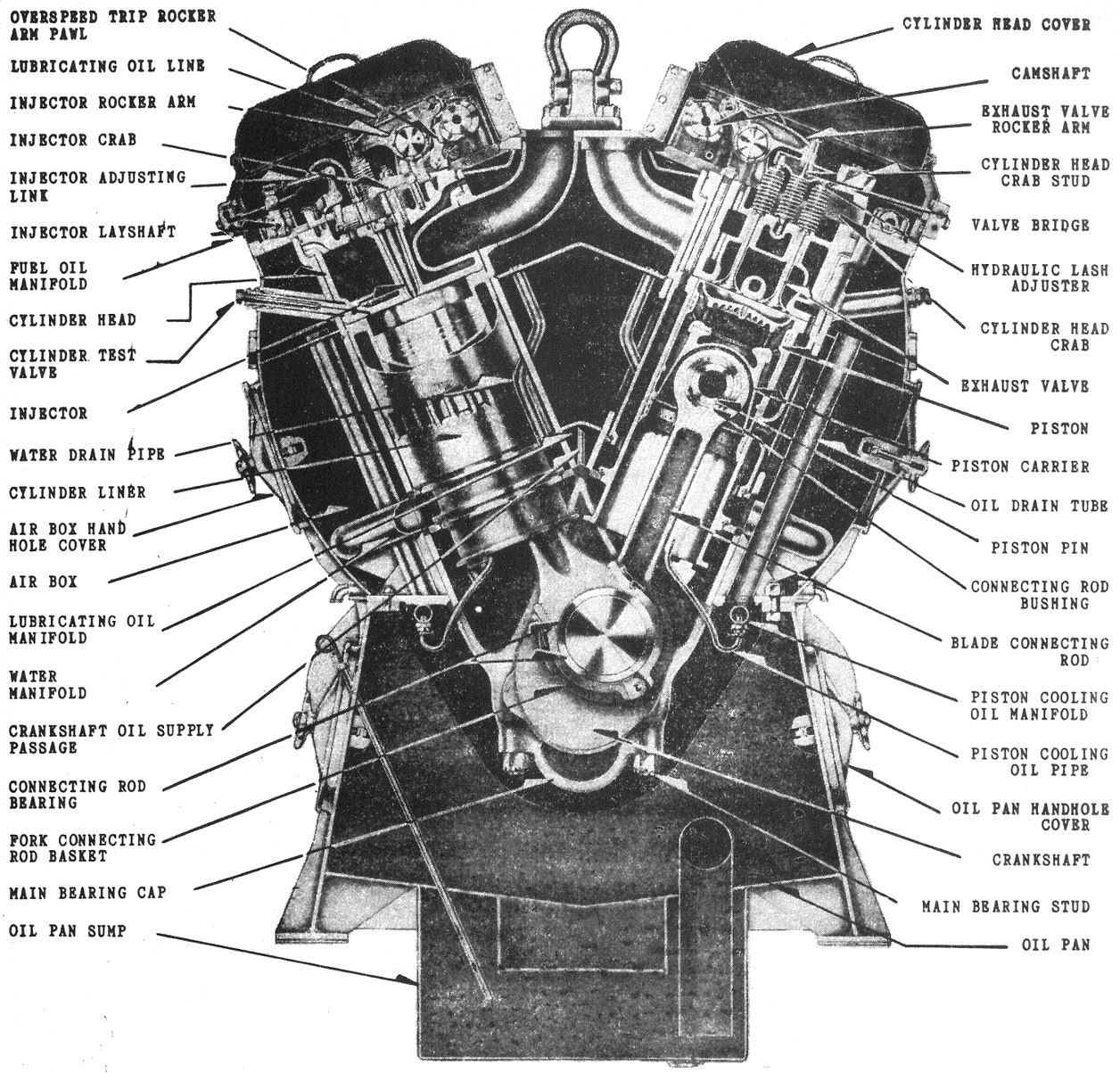


Cross section showing two pistons connected to one crankpin on a " vee form " diesel engine



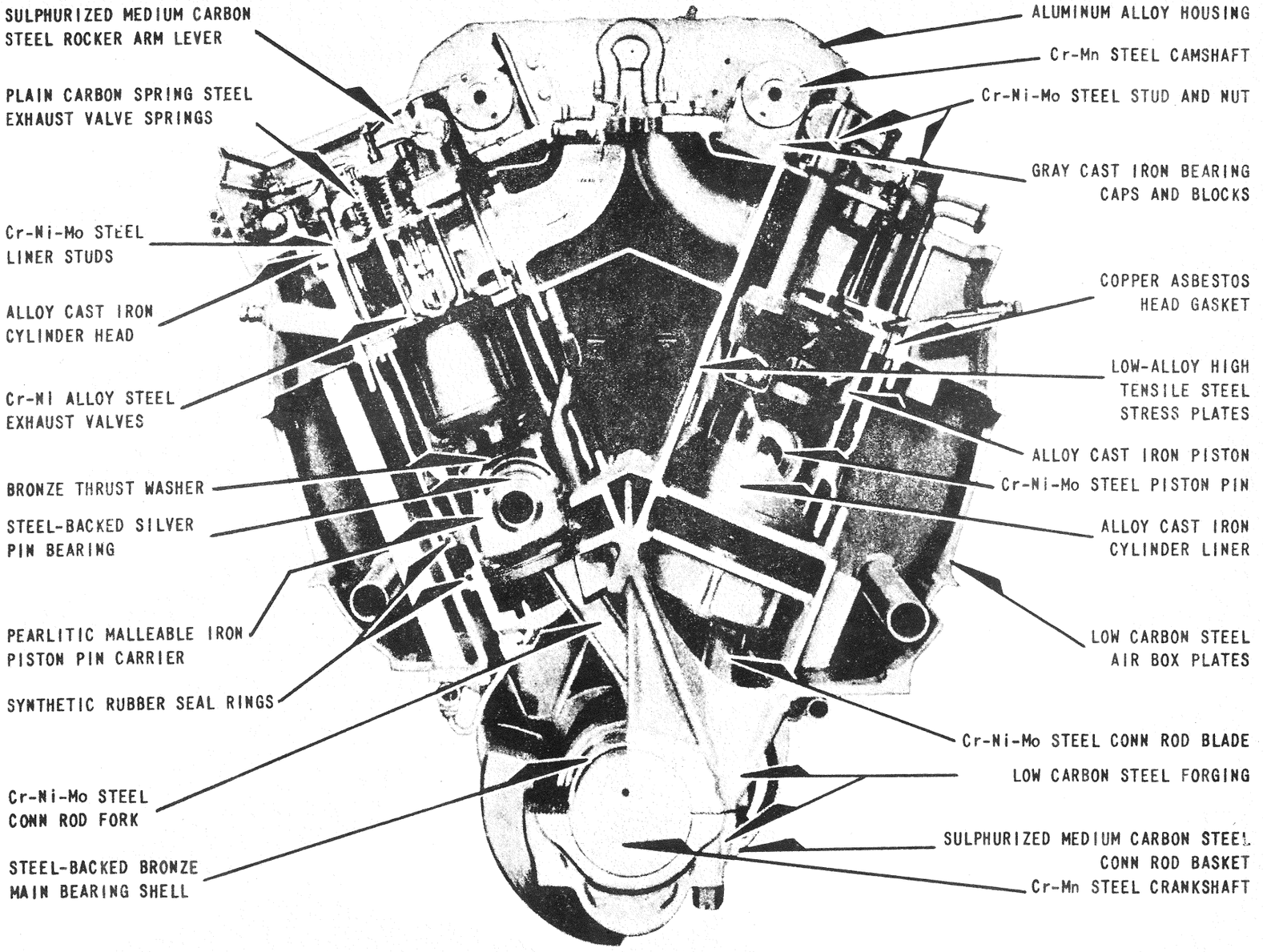
66/11

567 Series Engine Crankcase Cutaway View and Relief Valve



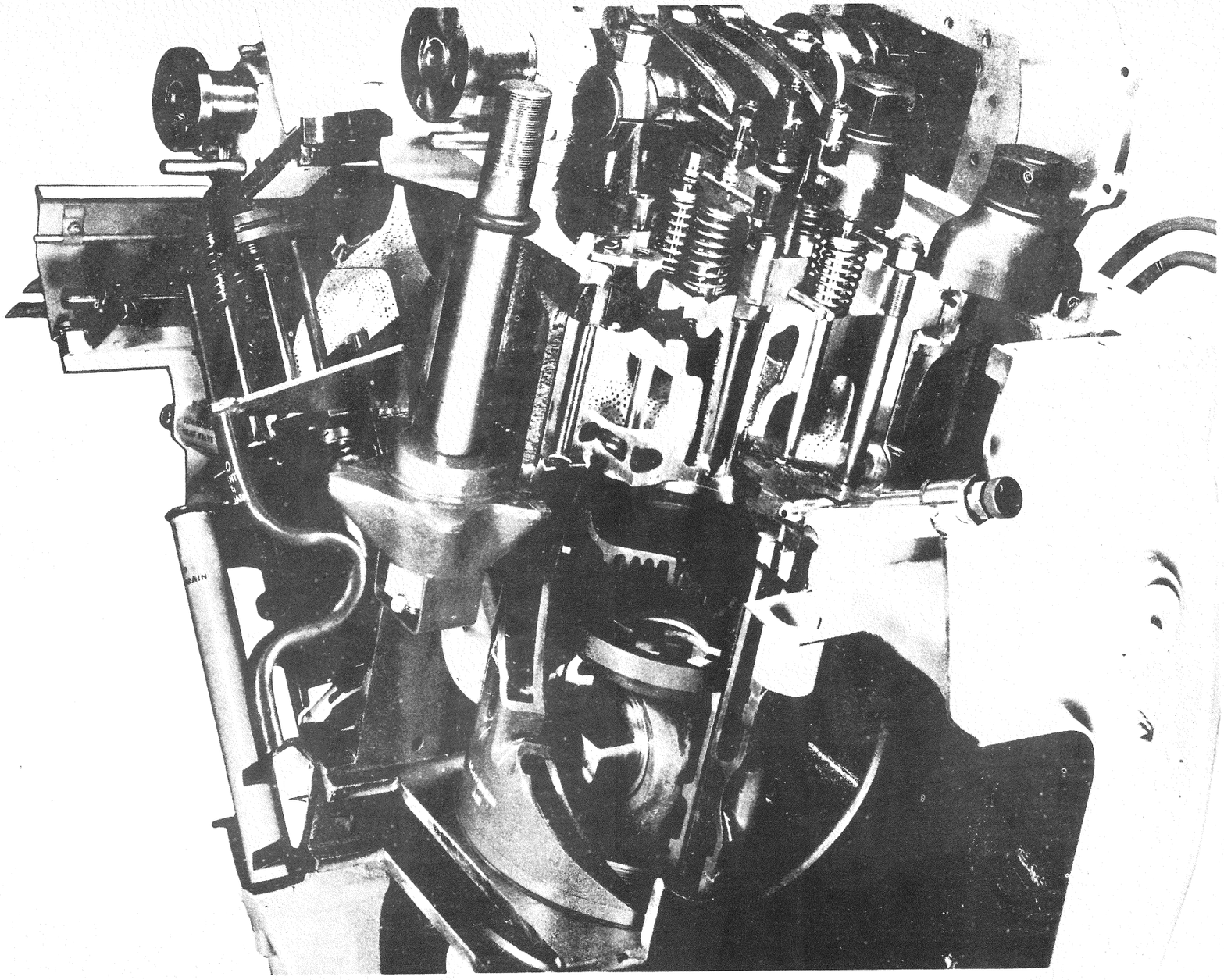
TWO STROKE 567 SERIES
DIESEL ENGINE

66/444



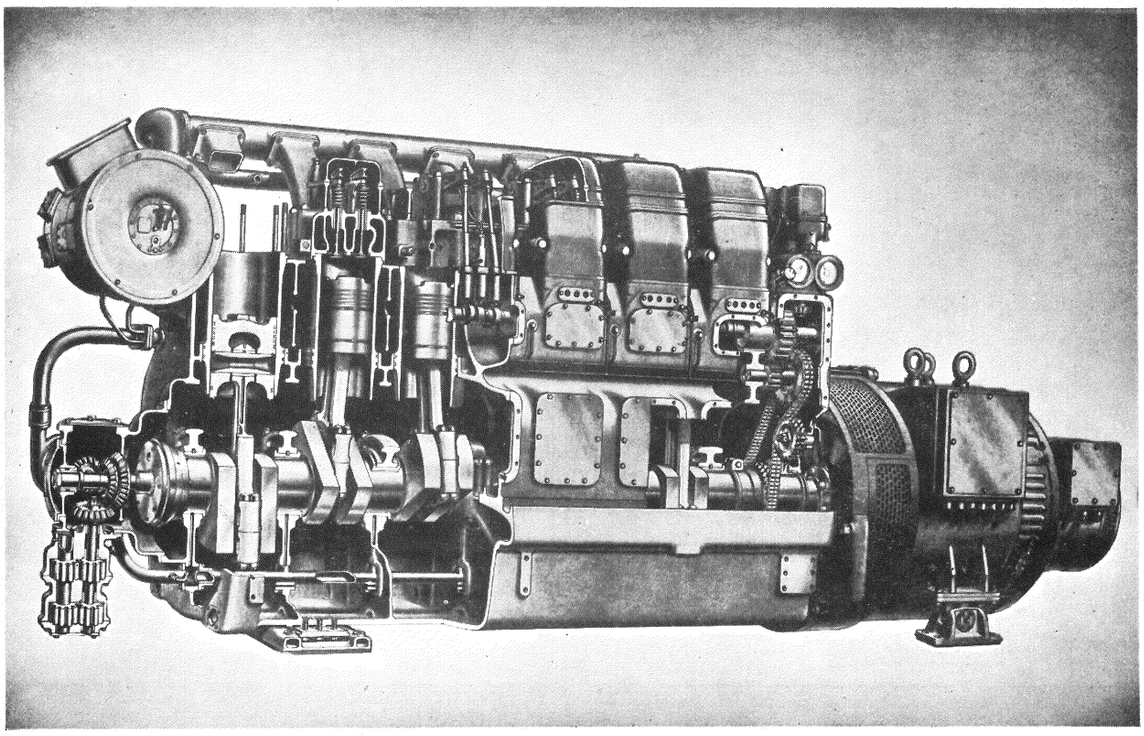
TWO STROKE ELECTRO–MOTIVE SERIES 567A & 567 B ENGINES

66/444

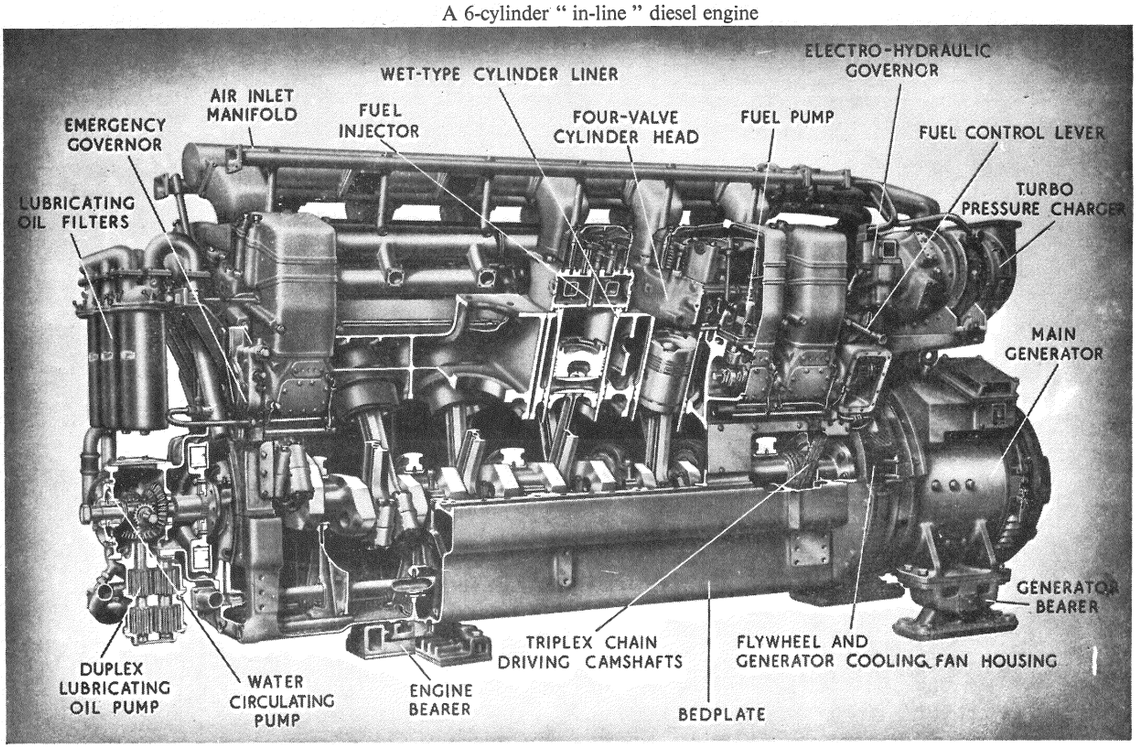


567 Series Engine Crankcase Cutaway View Two Stroke

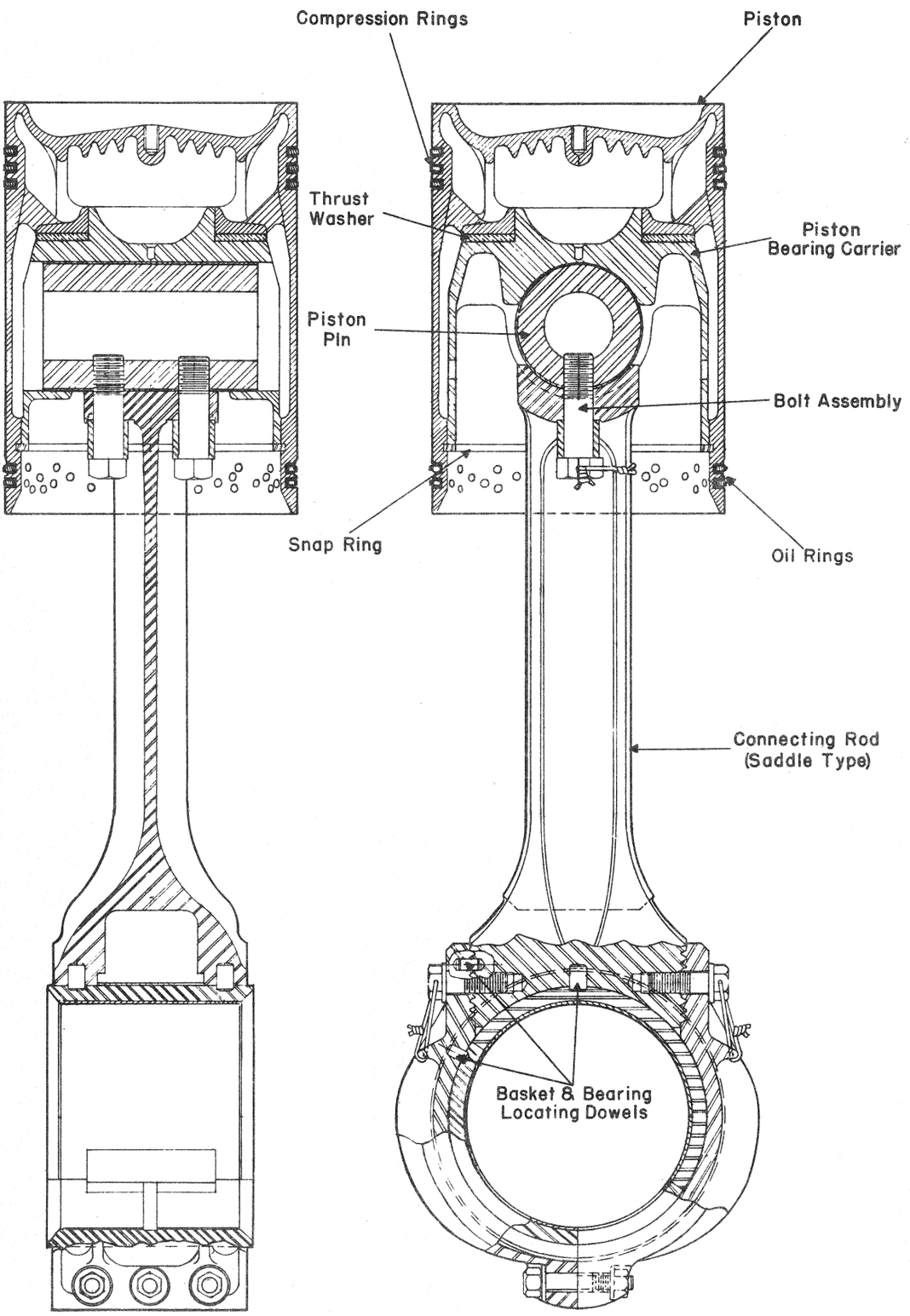
66/444



A 6-cylinder " in-line " diesel engine

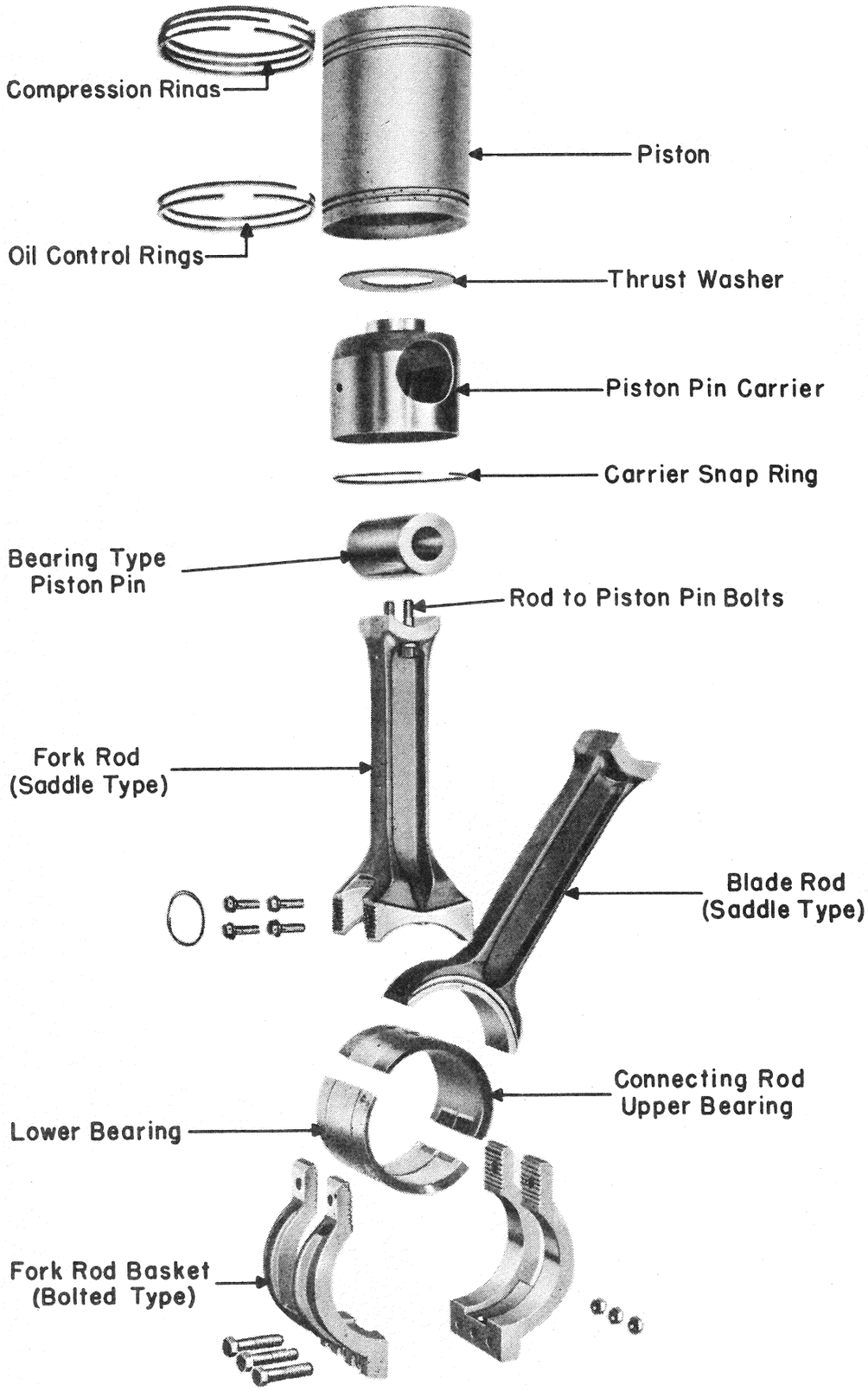


A 12-cylinder " vee form " diesel engine showing arrangements of cylinders, principal components and accessories



Piston And Connecting Rod (Cross-Section)

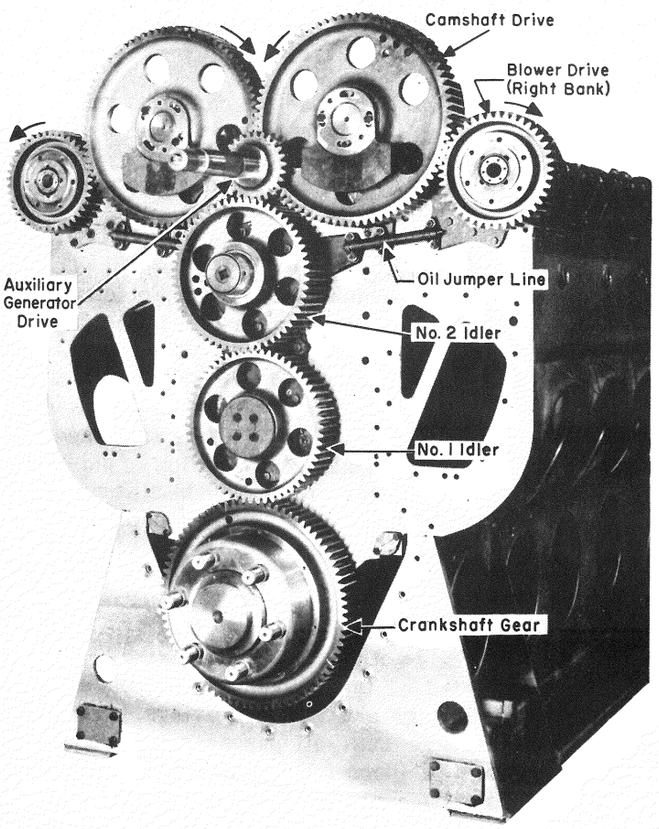
Da Locomotives



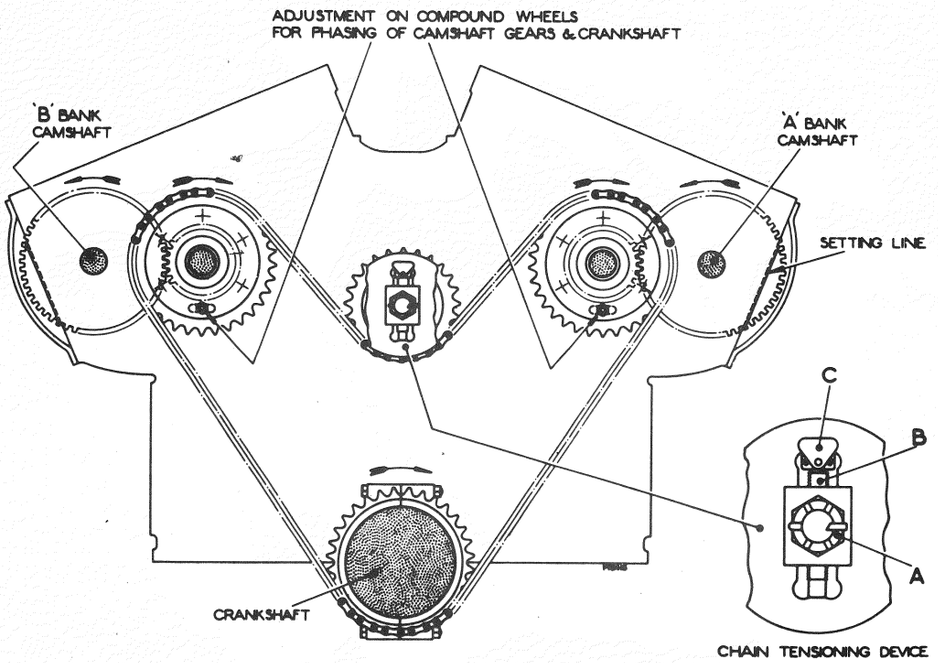
Piston And Connecting Rod Assembly

Da Locomotives

72/913



Camshaft Gear Train



Timing Chain