SECTION I

CRANKCASE AND OIL PAN

A. DESCRIPTION

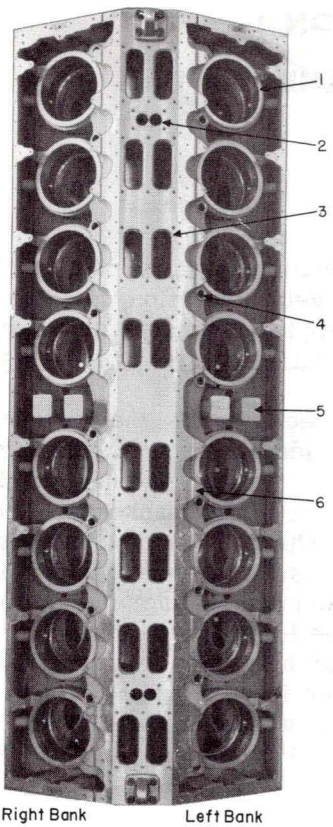
1. Crankcase

The crankcase is the main structural part of the engine, Fig. 1-1. It is a steel fabrication, forming a rigid self supporting assembly to accommodate the cylinder power assemblies and engine mounted accessories.

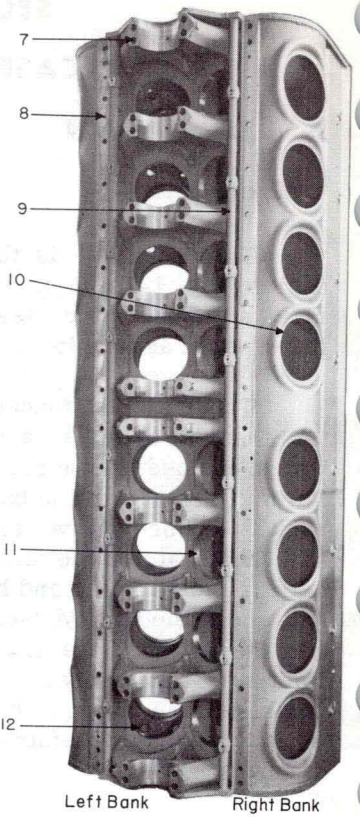
The major crankcase sections are the top deck, "A" frames, cylinder banks, side panels and end plates which enclose the assembly. The two cylinder banks left and right form the backbone of the crankcase. Each bank is formed by two steel channels welded together, with holes at top, bottom and sides at each cylinder location. Holes in top and bottom permit liner installation and accommodate replaceable lower liner pilot inserts and the holes in the sides or stress plate provide for liner port air supply and liner inspection. At each cylinder location on top of bank is a cylinder head retainer. Cylinder banks assembled in a crankcase form a "V" having a 45° angle.

The main bearing "A" frames integrate the bottom of the crankcase being welded to the cylinder bank stress plates and base rail. The "A" frames are line bored, provided with main bearings and caps to support the underslung crankshaft.

The air box is the area surrounding the liners formed by the cylinder banks and enclosed by the crankcase end plates and side panels. Two air inlet holes in the rear end plate permit air supply to the air box from the engine blowers to provide air for the cylinder liners. Handholes in the side panels provided with gasketed covers, Fig. 1-3, allow inspection of liners and pistons, cleaning of the air box, and access to mounting bolts.



Top View



Bottom View

1. Cylinder head retainer
2. Engine water outlet
3. Cylinder exhaust passage
4. Cylinder head locating and water discharge opening
5. Center crab support
6. Camshaft bearing support
7. Main bearing "A" frame
8. Air box drain hole
9. Piston cooling oil manifold
10. Air box inspection port
11. Liner pilot insert
12. Crab bolt seat

567C Engine Crankcase
Fig. 1-1

The upper deck of the cylinder banks separates the air box from the upper exposed part of the crankcase. Located on this deck are the cylinder head retainers of each bank joined at their inward side by the water discharge manifold. Exhaust elbows extend from each cylinder retainer through the water discharge manifold to the top deck of the crankcase. The forged camshaft supports with lined keyways are integral with the top deck which form a part of the water manifold. There is an individual discharge hole at each cylinder location for water discharge from the cylinder head. A tube extends from the outside of the crankcase into each retainer for application of the cylinder test valve. An oil drain channel runs the length of the crankcase adjacent to the outer side of the retainers, having drain pipes to empty return oil into the oil pan. These pipes serve also as ventilating tubes.

Two removable water inlet pipe manifolds, one on each side of the crankcase for each cylinder bank, are located at the outer bottom of the air box. At the front of the crankcase on each side a machined hole is provided to insert the water manifold. Two of the blower support capscrews extend through the rear end plate and are screwed into the plugged end of the manifold to hold this end. The front end of the manifold extends slightly beyond the front end plate where it is held in a counterbore of the water inlet elbow when applied and sealed with an "O" ring. Openings in the manifold at each liner location provide for the application of liner water inlet tubes with saddle type connection. (See Section 9 for particulars on water system components.)

Lubricating and piston cooling oil manifolds are incorporated as a part of the crankcase. The lubricating oil manifold is formed by a plate across the "V" junction of the inner stress plates running the entire length of the crankcase. An opening in the front end plate admits oil to the manifold and an opening in the rear end plate permits oil supply to the camshaft gear train. Oil pipes

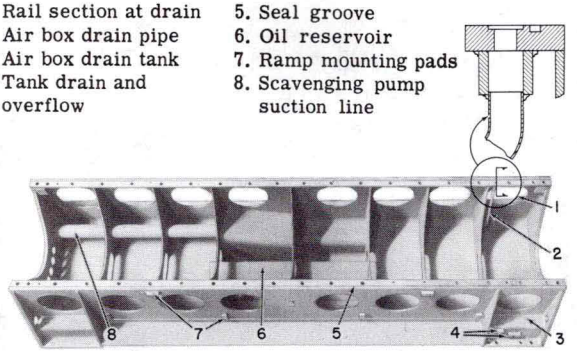
pressed into drilled passages through the main bearing "A" frames at their center, extend into the main lube oil manifold to supply each main bearing. Due to different length the 567C engine pipes cannot be used in other 567 series engines or vise-versa. The pipes extend above the bottom of the oil manifold to assure a clean oil supply. Piston cooling oil manifolds run parallel to the mounting rail at each side of crankcase. Piston cooling oil "Pee" pipe flanges are provided at each liner location.

Cylinder frames and covers are mounted on the crankcase to protect and enclose the operating mechanism. The cover frames are strongly fabricated and provide a flat seal surface on all top edges for the synthetic rubber seal in the light metal covers. Easily released latches hold the covers in place on the frame. Special hinges incorporated in the latches at the back of the covers permit covers to be removed, or raised without removal, to facilitate inspection. Cover support arms are provided to hold the cover open in selective positions.

NOTE: It should be noted that basic production model 567C engine crankcases have a different diameter upper liner pilot bore than some original pilot run models. All 567C engine crankcases starting serial #53-B-2 and engines starting serial #53-H-75 (16-567C) have an upper liner pilot bore diameter of 12.091" nominal. 567C engines and crankcases preceding these serial numbers (which have not been reworked) have upper liner pilot bore diameters of 12.061" nominal. Consequently, different size liners are used in crankcases having different bore diameters. See Section 4 for liner particulars.

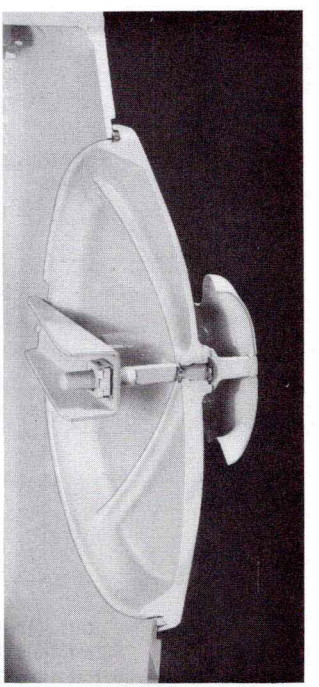
2. Oil Pan

The oil pan, Fig. 1-2, is a steel fabricated assembly. It supports the crankcase and serves as the engine base. Incorporated in the oil pan is the engine oil sump, located centrally in the pan, provided with oil drains.



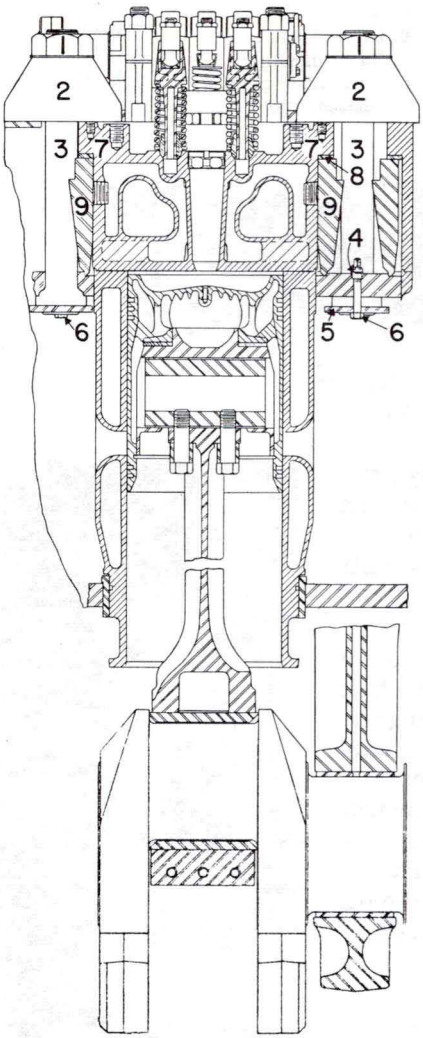
Oil Pan
Fig. 1-2

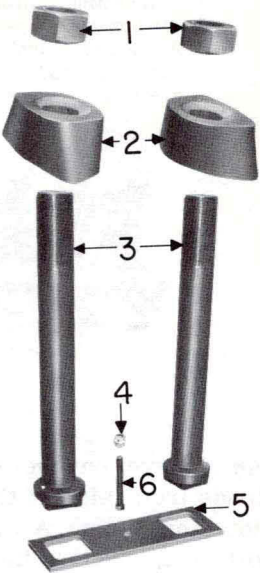
An oil level bayonet gauge extends from side of the oil pan into the sump. A scavenging oil pump suction line is built into the oil pan extending from the sump to the front end plate. Openings in each end plate allow oil from the camshaft and accessory end housings to drain into the oil pan. Handholes at each cylinder location, provided with gasketed covers, Fig. 1-3, allow access to enclosed engine parts. Separate air box drain tanks in the oil pan receive any liquid accumulations from the air box through a drain pipe and passage through the oil pan and crankcase mounting rails.

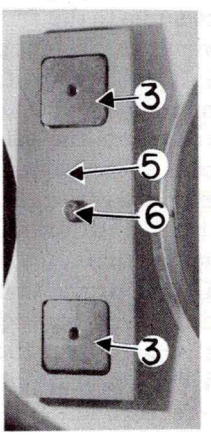


Handhole Cover - Section
Fig. 1-3

The seal arrangement between crankcase and oil pan mounting rails consists of a silicone rubber cord placed in







1. Crab Nut
2. Crab
3. Crab Bolt
4. Retainer Bolt Nut
5. Retainer Plate
6. Retainer Bolt
7. Cylinder Head
8. Cylinder Head Seat Ring
9. Cylinder Head Retainer

Crab Bolt Assembly
Fig. 1-4

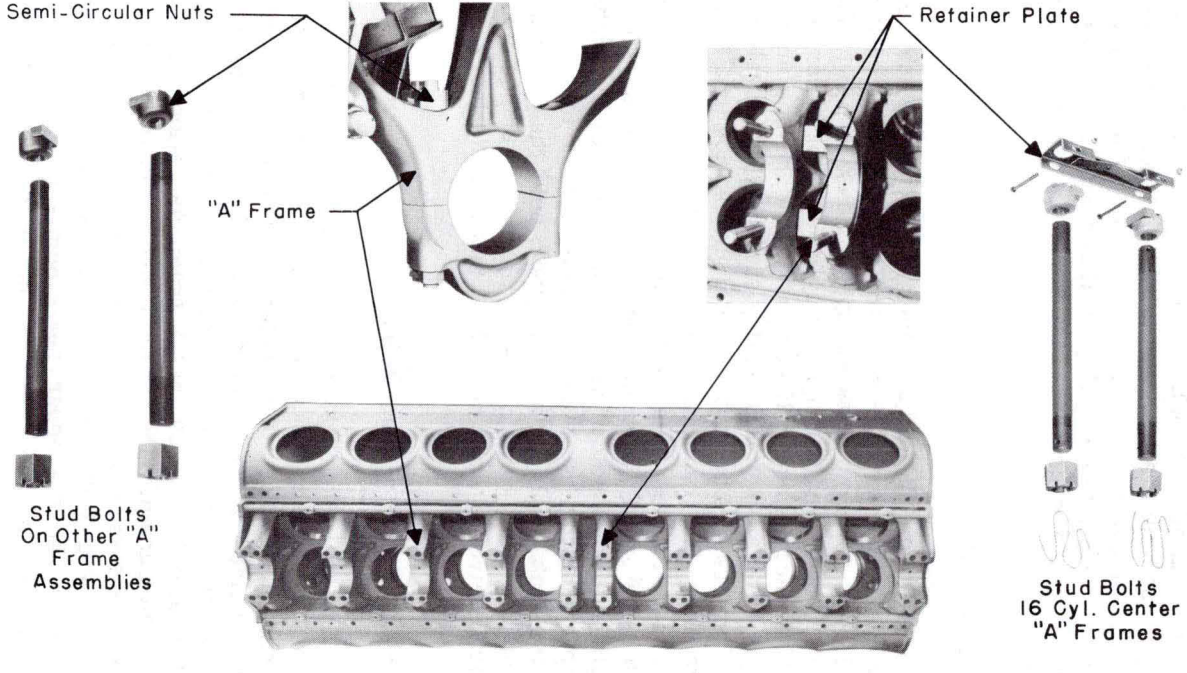
a groove outside the bolt line the entire length of each oil pan mounting rail. A small "O" ring seal placed in a counterbore, seals the air box drain opening. Dowels hold the crankcase to oil pan alignment after original assembly and crankcase to oil pan bolts secure the assembly.

3. Crab Bolts

The cylinder head and liner are bolted together and are held after installation in their respective locations by 1-3/4" - 12 crab bolts and upper crabs, Fig. 1-4. The crab bolts extend through the cylinder bank upper deck plate adjacent each cylinder retainer. The bottom bolt heads have a spherical seating surface which seat in a like surface, the bolts being held in position by a separate plate and capscrew for each pair of bolts. The square bolt heads fit a corresponding hole in the plate which prevents their turning when being torqued. Lower crabs are not used on the "C" crankcase. Upper crabs, each contacting two cylinder heads, except for end or center crabs on 16-cylinder engines, hold the power assemblies firmly in place. A top spherical surface of the crab receives a crab nut with a mating spherical seat.

4. Main Bearing Stud Bolts

The main bearing stud bolts are shown in Fig. 1-5. Each "A" frame has four 1-1/4" - 12 lubrized main bearing studs except the center "A" frames on 16 cylinder engines which have two each. They pass through the "A" frame and main bearing caps with their lower end about 6-1/2" below the "A" frame serrations. Lockwire holes are provided at the lower end of the stud. A 5/16" transverse hole at the upper end of the stud accomodates a 1/4" bolt which passes through the stud and slots in the upper nut. Semi-circular or "D" shaped nuts are used at the upper end of the stud. The flats of adjacent nuts mating to prevent turning. The upper nuts have a spherical seating surface to



Main Bearing Stud Bolts
Fig. 1-5

match a similar surface in the "A" frame. Since the center "A" frames of the 16 cylinder engine are at a distance from each other, a retainer assembly is used to prevent the upper end nuts from turning. The retainer assembly is held in place over the nuts by the 1/4" bolts which pass through the nuts and studs. The lower main bearing nuts are conventional slotted hexagon nuts using lockwire to aid in securing the nuts.

Original main bearing stud "D" shaped nuts had a special insert to lock the stud. These have been superceded by the nuts described using pinning bolts. Also, the retainer described replaces the prior used retainer which was secured by 3/8" capscrews vertically run into the center bearing stud at the top. See item 2, under Maintenance for use of the new parts with old studs.

A serrated joint is used at the "A" frame to cap parting line. Since the caps are applied to the "A" frames and then line bored, each cap must be kept with its "A" frame; they are not interchangeable. To identify matching "A" frame and its cap, both are stamped with corresponding bearing number.

5. Engine, Crankcase and Oil Pan Serial Numbers

Engine serial numbers are stamped on the identification plate, listing model of engine, located on the right side about six inches below the cylinder cover frame base between the center cylinders. Also, serial numbers are stamped at front left corner of crankcase under cover frame base. The engine serial number consists of month and year of manufacture plus the consecutive engine of the month in which it was built. An alphabetical letter represents the month, as "A," "B," "C" corresponding to "A" January, "B" February and so forth, except "I" which is not used. For example, 54-E-125, identifies the 125th engine built in May, 1954.

Each month the letter is changed and numbers start again at 1, the year symbol corresponds to the last two figures of the current year.

Crankcase serial numbers also have (like engines) the year, month of manufacture and the consecutive crankcase number manufactured that month. The crankcase serial numbers are located on the right side of each main bearing cap and end "A" frames, as well as under each camshaft at the center of the engine. The word "crankcase" should be used when referring to the crankcase serial number to avoid misinterpretation between crankcase and engine serial numbers.

Oil pan serial numbers are located on the left side of the oil pan near the crankcase support base at the front or rear.

B. MAINTENANCE

1. Crankcase To Oil Pan Seal Application and Tightening

Before seal application inspect oil pan rails for nicks, burrs, or foreign material of any kind in seal grooves, and remove to provide a clean smooth surface. Any indentation in the seal grooves or base rails that would allow oil seepage must be filled with solder and finished flush with affected area.

Along outside edge of oil pan rail surface, apply one coat of Tite Seal #3, approximately 1/2" width and about .015" thick, or thickness of ordinary playing card.

Install seals in grooves without twisting or stretching and without lubricant. The individual seals for each model engine are longer than required but do not cut off seal ends at this time.

Place crankcase over oil pan, and using line up pin guides in the four corner holes, lower crankcase on oil pan. Apply taper dowel bolts and tighten. Check crankcase to oil pan alignment, using care not to damage seal cord.

CAUTION: Do not pull or stretch the ends of seal cord.

Assemble all crankcase to oil pan bolts with washers and snug four corner bolts to about 100 ft. lbs., torque. Then torque all bolts to about 100 ft. lbs., in sequence as shown in Table 1 starting with #1 bolt. Repeat same sequence and tighten all bolts to 450 foot pounds.

After all bolts have been tightened to 450 ft. lbs., cut seal cord ends to provide a seal protrusion from face of end plates of 3/32" ± 1/64". This seal protrusion will seal the three way joint of oil pan, crankcase and end housing.

All crankcase to oil pan bolts must be tightened at regular intervals, in accordance with mileage indicated in the Scheduled Maintenance Program.

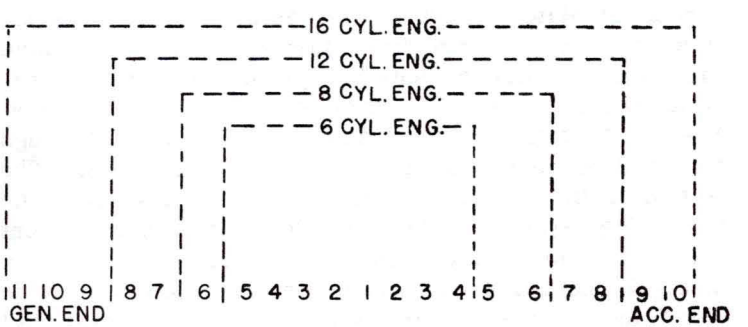


Table 1 - Crankcase To Oil Pan Bolt Tightening Diagram

2. Main Bearing Studs

Thread size at both ends of main bearing stud bolt is 1-1/4"-12. To clean up threads, a 1-1/4"-12 thread die 8060349 can be used, while 1-1/4"-12 tap 8060387 can be used on the stud nuts. To aid in obtaining correct torque values the threads should be cleaned before parts application.

Upon application, each stud is inserted into its place in the "A" frame and run into its nut until the 5/16" hole in the top of stud lines up with the bolt slot of the nut. The lockwire end of the stud should be 6-1/2" $\pm$ 1/16" from the serrations on the "A" frame when the stud is brought out with the spherical surface of the upper nut contacting its like surface in the "A" frame. This is to assure the lockwire passing through the slots of the lower stud nuts when the bearing cap is applied and the nuts tightened properly. The 1/4" bolt and self locking nut may then be applied to all the upper nut and stud assemblies except the center "A" frames on 16 cylinder engines. The upper nut flats contact each other when in place on all "A" frames except the center "A" frames on the 16 cylinder engines which are separated from each other. A retainer plate is used on the center "A" frame upper nuts to prevent them from turning. After the stud has been run into the nuts the proper amount the retainer which is like a channel is placed over the nuts. The 1/4" bolts are then applied which pass through the retainer and stud and across the nut slots. The bolt slots in the retainer are of different widths, one slot being larger to take the bolt nut head and prevent it from turning when tightened. The retainers may be a straight channel or cut away on one side to provide clearance for a stiffener plate between the center "A" frames on later 16 cylinder engines. The first crankcase having this stiffener has serial number 55B-21 in engine having serial number 55C-116.

Original main bearing studs do not have the 5/16" through hole at the top but have a 3/8"-24 tapped hole at the top of the stud which is used to secure the center bearing stud nut retainer originally used. Also the original stud nuts have a special insert in addition to the regular nut thread. These parts have been discontinued and replaced by the similar parts previously described. If a slotted nut and 1/4" bolt is to be used on an original design stud, the stud must have a 5/16" hole drilled through at a 14-13/16" dimension from the bottom or lockwire end of the stud. The threads should then be recleaned after drilling. If either a new nut or new retainer has to be applied on old style studs at the center "A" frames of a 16 cylinder engine, both studs must be drilled and both nuts and retainer must be of the new design.

In application of the original studs using insert type upper nuts, both studs are run in up to the insert, then each stud is run into the insert to maintain correct length from the "A" frame serrations, 6-1/2" $\pm$ 1/16"; the retainer is secured by 3/8"-24 capscrews in the center "A" frame studs. Upon removal of these studs, both should be backed out of the insert before individual removal.

Main bearing caps are originally applied to the "A" frame and then are line bored; therefore, they are not interchangeable or available for replacement. They must be re-applied on the same "A" frame in the same original position as removed. Each cap and "A" frame is stamped on the right side with their bearing number, and in addition, all caps and the end "A" frame are stamped with the crankcase serial number. Before cap application, check serrations in cap and "A" frame and remove any burrs or foreign material to provide a good mating fit.

Torque value of the main bearing nuts is 500 to 800 ft. lbs. For correct assembly, the nuts should be

brought up to 500 ft. lbs. and then tightened further until line up of first lockwire hole is reached. This will assure torque value being within the 500-800 ft. lb. range.

For checking main bearing bore dimensions, a torque value of 650 ft. lbs. should be used. When nuts are torqued this amount the out-of-round limit of the main bearing bore is .005". Likewise, the main bearing bore dimensional limit at this torque is minimum 8.249" and maximum 8.252". These are the average of six (6) measurements, three (3) taken at each end of the bore. The crankcase main bearing bore measurements must be within these limits to qualify for use and to assure that the bore is not "closed-in." (A previously used serration gauge 8177167 is no longer recommended for qualifying the main bearing bore.)

If an overheated bearing makes it necessary to check an "A" frame for "close-in" with the crankshaft in the engine, it may be checked using a new upper main bearing. In this check, the "A" frame bore must be able to receive a new upper main bearing shell. Also, there must be at least .0015" clearance at each side between the bearing shell and the crankshaft at the split line above the serrations.

Main bearing wrench set 8250854 similar to set 8155363 used on the other series of 567 engines may be obtained for use on the 567C engine. This wrench in use is supported in the oil pan inspection opening. Also, a 8191591 offset ratchet set is available for running up and loosening main bearing nuts. For information on these tools see the latest revision of Tool Catalog #91.

3. Crab Bolts

After upper crab bolt nuts are removed the bolts may be removed through the air box after removing crab

bolt retainer plate capscrew and plate. Crab bolt threads may be cleaned up using 1-3/4" - 12 thread die 8067409, and nut threads cleaned up using tap 1-3/4"-12 8050688. Whenever crab bolt threads are exposed, they should be protected with thread caps 8034600. All crab bolts now are 15-1/16" long, compared to the original length of 16-1/16".

Torque value of the cylinder head crab nuts is 1800 ft. lbs. $\pm$ 5%. A powerench set 8250885 for tightening crab nuts is available through our Parts Department. This is a mechanical advantage wrench employing a standard torque wrench.

Before application or re-assembly of the crab, spherical washer or nut, examine for burrs, roughness or galling which would effect the true torque value. They should also be lubricated at time of assembly, using a lubricant having specifications similar to Texaco Stud Lube 921 or engine lube oil.

Crab bolt nuts should be tightened in two passes, half total torque at each pass, tightening the diagonally opposite nuts alternately to form a letter "X." This method applies whether tightening an entire bank or a single cylinder. After final cylinder assembly, bring engine water temperature to 170° F. and re-torque crab nuts and liner stud nuts to proper torque. Recheck at intervals specified in the Scheduled Maintenance Program.

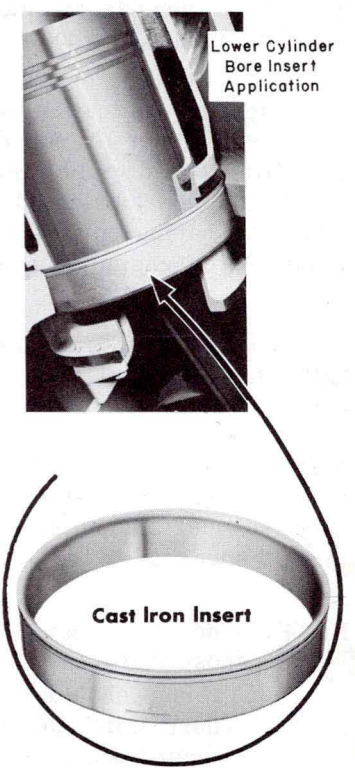
NOTE: When liner and crab nuts are being retightened, those that move at less than the specified torque values, should be tightened to proper value. Those which DO NOT MOVE, below or up to the proper values, should be checked by pulling up to a value not exceeding 10% more than recommended torque.

4. Lower Cylinder Bore Insert

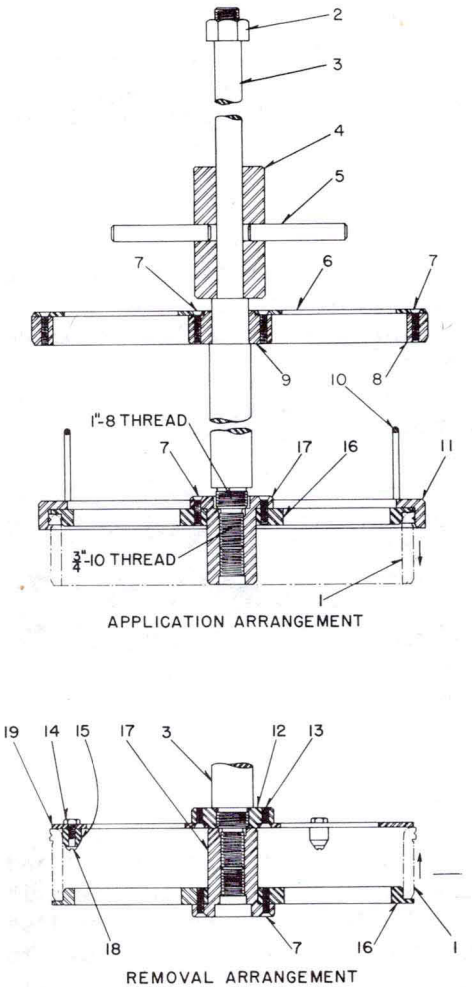
A replaceable phosphate treated cast iron insert, Fig. 1-6, is used in the lower cylinder bore of the crankcase to provide a wear surface at the lower liner pilot. Seals held in grooves in the lower liner pilot prevent air passage between the insert and the liner.

When the inside diameter of the insert reaches a diameter of 10.386", the insert should be removed and a new one installed. Clearance between the lower liner pilot and the insert should also be checked so as not to exceed a liner pilot diametral clearance of that shown on Fig. 4-7, Section 4. Minimum wall thickness of the insert is .339".

Tool 8212763 is used to apply or remove the inserts. Before applying the inserts, coat the outside diameter with a lubricant such as white lead or similar type lubricant. To apply the insert, position it in the tool, as indicated in the application arrangement shown in Fig. 1-7. The insert is then positioned in the crankcase bore and driven all the way down into the bore using the striker at the top of the spindle. The insert outside diameter is such as to provide approximately a .004" to .009" interference fit in the crankcase bore.



Lower Cylinder Bore Insert
Fig. 1-6



1. Insert
2. 3/4"-10 Nut
3. Spindle
4. Striker
5. Dowel Handle
6. Center Plate
7. Screw
8. Center Ring
9. Center Bore
10. Handle
11. Holding Ring
12. Boss Nut
13. Screw
14. Nut
15. Bushing
16. Puller Plate
17. Boss Nut
18. Screw
19. Clamp Plate

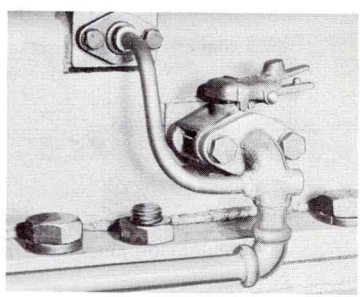
Crankcase Insert Applying Or Removing Tool
Fig. 1-7

The tool removal arrangement shown in Fig. 1-7 is used to remove an insert, using the striker as before, but in the opposite direction.

In the event that the insert installing and removing tool is not available, the insert may be applied or removed by carefully using a mallet and phenolic or wooden blocks.

5. Air Box Drains

The engine air box accumulation settles in the two drain tanks incorporated one on each side at the rear of the oil pan. Valves are provided for drainage of these tanks by a syphon arrangement. The tanks should be drained at appropriate frequent intervals with attention given to the discharge noting if there is any water or excessive oil accumulation in the air box. If a discharge is noted from the drain pipe with the air box drains closed, the air box accumulation should be investigated.



Air Box Drain Valve
Fig. 1-8

6. Crankcase Inspection

Serious crankcase failures can be avoided and longer crankcase life obtained by careful periodic crankcase inspection. Careful inspection may disclose small discrepancies which, if they were allowed to progress, might result in major failure, loss of service, or loss of the crankcase. Inspection and early trouble detection and repair are most important, since major repair generally cannot be done in the field. In instances where major repair is involved requiring extensive welding, it is essential that the crankcase be

stress relieved and remachined where necessary. This tends to shorten crankcase life, as there is a limit to number of times this can be done.

In addition, when an engine failure occurs due to breakdown of parts, a careful inspection is essential at locations other than the immediate damaged area. (For example, an engine failure in which a connecting rod damages the liner pilot and plate.) A rod may also strike and nick the stress plates. It is most important in this event that the stress plate be inspected in the holes opposite the liner and if any nicks are found, they must be blended out. The stress plates are subject to shock loading and nicks may serve as a possible stress concentration that may lead to cracking. It is recommended that crankcase requiring rebuild or reconditioning be returned for the work.

7. Return of Engine Crankcases

It is essential that the crankcase, oil pan and cover frame be maintained the same length to assure proper assembly of end housings and parts. Therefore, when returning crankcases, the oil pan and cover frame should be returned, so that in the event the crankcase end plate requires machining, the oil pan and cover frame can be machined to match.

8. Cleaning Crankcase

The crankcase should be cleaned after any work has been done on the interior of the engine, to remove particles of metal or dirt. This can be done by using spray gun #8193041 and solvent. The equipment near the engine should be protected against the spray. After spraying the top deck (cylinder heads, rocker arms, etc.), wipe with towels saturated with solvent. Wipe up all solvent trapped in corners and pockets. Use only lintless, bound-edge towels.

Cleaning of the air box with a spray gun while liners are in place is not recommended practice, due to possibility of solvent entering liners at the ports. If cleaning the air box with liners in place, use only bound-edge towels and petroleum solvent.

At any time cleaning is done on the crankcase, care should be given to oil passages, bearing surfaces, gears, etc., that gritty material will not be trapped. Cleaning information on the crankcase and other engine parts is contained in Maintenance Bulletin #1706.

9. Engine Painting

If an engine is to be removed from service and completely overhauled and the interior repainted, the parts to be painted must be cleaned in a vat of caustic solution to remove old paint, grease and oil from the pores of the metal. The caustic solution must be thoroughly removed by washing the parts in clean hot water, and air dried with an air hose. (Aluminum parts must not be washed in the caustic solution.) If caustic cleaning is not done before painting, the paint will peel off the interior of the engine and restrict the lube oil lines. Mask off parts not to be painted.

Use crankcase paint (5 gal. 8187782, 1 gal. 8187781) on the following: interior of crankcase, oil pan, blower supports, top deck, cylinder head cover frames (except on seal surface), accessory and camshaft drive housings. Do not paint any machined surfaces, liners, heads or seal surfaces.

To refinish the exterior of the engine, remove all grease and oil, using an alkaline cleaner. Mask off water, fuel, and oil connections. If required, apply coat of primer, either number given above. Then apply a finish coat of Suede Gray, 5 gal. 8133054, 1 gal. 8122047. (Larger containers of all the preceding paint are available, if desired.)

C. SPECIFICATIONS

Main Bearing Bolts	
(length from serrations)	6-1/2" ± 1/16"
Main Bearing Bores	
Diameter - Average of 6 readings, 3 at each end of bore, 60° apart, starting at the vertical centerline with the main bearing nuts torqued to 650 ft. lbs.	Min. 8.249"
	Max. 8.252"
Out-of-round	Max. .005"
Liner Bore Dimensions	
Upper liner pilot	
12.091" nominal bore	Max. 12.104"
12.061" (pilot Model 567C only)	Max. 12.079"
Lower liner pilot (insert)	
10.377" nominal bore	Max. 10.386"
Insert wall thickness	Min. .339"

D. EQUIPMENT LIST

	Part No.
Main bearing nuts powerench set	8250854
Main bearing cap lifter	8252846
Main bearing nut offset ratchet wrench	8191591
Main bearing bolt thread die 1-1/4" × 12	8060349
Main bearing nut tap 1-1/4" × 12	8060387
Crab nut powerench set	8250885
Crab stud thread protectors	8034600
Crab stud thread die 1-3/4" × 12	8067409
Crab nut tap 1-3/4" × 12	8050688
Insert installing and removing tool	8212763
Spray gun (for engine cleaning)	8193041
Towels (bound-edge wiping towels)	8050752
Crankcase paint	
5 gallon	8187782
1 gallon	8187781
Suede gray paint	
5 gallon	8133054
1 gallon	8122047