Universal

OPERATION AND MAINTENANCE MANUAL

100% MARINE ENGINE

SINCE 1898 • OSHKOSH, WISCONSIN

UNIVERSAL MOTOR COMPANY

INSTALLATION, OPERATION and MAINTENANCE INSTRUCTIONS for UNIVERSAL MARINE ENGINES

BLUE JACKET TWIN, ATOMIC FOUR, UTILITY FOUR, SUPER-FOUR, UNIMITE FOUR, ARROW (SIX), BLUEFIN (SIX), MARLIN (SIX), TARPON (SIX), KNIGHT (SIX), LITTLE KING V-8 and BIG KING V-8 MODELS

MARINE ENGINE WARRANTY

PRODUCT WARRANTY

SELLER WARRANTS ALL PRODUCTS AND PARTS OF ITS OWN MANUFACTURE AGAINST DEFECTS IN MATERIAL OR WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM DATE OF SHIPMENT WHEN GIVEN NORMAL AND PROPER USAGE AS DETERMINED BY SELLER UPON EXAMINATION, AND WHEN OWNED BY THE ORIGINAL PURCHASER. COMPONENTS PURCHASED BY SELLER AS COMPLETE UNITS AND USED AS AN INTEGRAL PART OF SELLERS EQUIPMENT WILL BE COVERED BY THE STANDARD WARRANTY OF THE MANUFACTURE THEREOF. SELLER WILL REPAIR OR REPLACE F.O.B. ORIGINAL SHIPPING POINT (BUT NOT INSTALL) ANY PART OR PARTS OF ITS MANUFACTURE WHICH, IN ITS JUDGMENT, SHALL DISCLOSE DEFECTS IN EITHER MATERIAL OR WORKMANSHIP. IF REQUESTED BY SELLER, PARTS FOR WHICH A WARRANTY CLAIM IS MADE ARE TO BE RETURNED TRANSPORTATION PREPAID TO OUR FACTORY. THIS WARRANTY BECOMES VOID IF ARTICLE CLAIMED TO BE DEFECTIVE HAS BEEN REPAIRED OR ALTERED IN ANY WAY OR WHEN THE ARTICLE HAS BEEN SUBJECT TO MISUSE, NEGLIGENCE OR ACCIDENT OR WHEN INSTRUCTIONS FOR INSTALLING OR OPERATING HAS BEEN DISREGARDED. WE MAKE NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKE NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE, AND THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. NO EMPLOYEE OR REPRESENTATIVE IS AUTHORIZED TO CHANGE THIS WARRANTY IN ANY WAY OR GRANT ANY OTHER WARRANTY. THE REMEDIES HEREINABOVE AFFORDED TO THE PURCHASER ARE EXCLUSIVE OF ALL OTHER REMEDIES PROVIDED BY LAW. SELLER SHALL NOT BE LIABLE FOR INDIRECT OR CONSEQUENTIAL DAMAGES WHERE THE LOSS SUSTAINED IS OF A COMMERCIAL NATURE.

PRODUCT IMPROVEMENTS

THE MANUFACTURER RESERVES THE RIGHT TO MAKE PRODUCT IMPROVEMENTS AT ANY TIME WITHOUT TAKING RESPONSIBILITY OR OBLIGATION TO MAKE SIMILAR CHANGES OR ADD SIMILAR IMPROVEMENTS ON ANY ENGINES DELIVERED PRIOR TO THOSE CHANGES.

WARRANTY REGISTRATION

ENCLOSED WITH EACH ENGINE IS A WARRANTY REGISTRATION CARD. THIS CARD MUST CONTAIN THE OWNER'S NAME, ADDRESS, SERIAL NUMBER OF THE ENGINE, V-DRIVE AND REVERSE GEARS AND RETURNED TO MEDALIST BEFORE THE WARRANTY BECOMES EFFECTIVE. THIS WARRANTY REGISTRATION MUST TAKE PLACE WITHIN 24 HOURS AFTER RECEIPT OF THE ENGINE.

WARRANTY EXCLUSIONS

THE FOLLOWING SERVICES AND EQUIPMENTS WILL NOT BE REIMBURSED UNDER THE WARRANTY:

1. REPAIRS DUE TO NEGLECT, MISUSE, IMPROPER APPLICATION, ACCIDENT, RACING AND INSTALLATIONS THAT DO NOT MEET MINIMUM STANDARDS AS SET FORTH IN THE INSTRUCTION MANUAL.

2. TUNEUP OR ADJUSTMENT EXPENSES NEEDED FOR CLEANING OF FUEL SYSTEM COMPONENTS DUE TO CONTAMINATION.

3. DAMAGE OR LOSS TO PERSONAL PROPERTY, LOSS OF REVENUE, TOWING CHARGES, STORAGE FEES, FUEL AND TELEPHONE CALLS.

4. DAMAGES OR LOSSES RELATED TO HANDLING AND SHIPPING.

5. EXPENSES RELATED TO REPLACEMENT OF LUBRICANTS, ANTI-FREEZE OR SPECIAL ADDITIVES.

6. FAILURE DUE TO NOT FOLLOWING RECOMMENDED MAINTENANCE SCHEDULES.

7. ALL TRANSPORTATION CHARGES WILL BE THE OBLIGATION OF THE OWNER, SUCH AS FREIGHT, TRAVEL TIME, AND TOLLS.

8. WARRANTY ITEMS RETURNED TO THE FACTORY COLLECT WILL BE BILLED TO THE SHIPPER.

WARRANTY AUTHORIZATION

PRIOR AUTHORIZATION IS REQUIRED FROM THE FACTORY WHERE COMPLETE REPLACEMENT OR OVERHAULING OF THE FOLLOWING IS NECESSARY:

1. COMPLETE ENGINE ASSEMBLY

2. CYLINDER HEADS OR ENGINE BLOCK.

3. MARINE REVERSE GEAR OR V-DRIVE.

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THE UNIVERSAL GUARANTEE

All UNIVERSAL products are thoroughly tested prior to shipment from the factory and are certified free from defects in material and workmanship. The finest materials and components available are used throughout. The Universal Motor Company guarantees the products of its own manufacture against defects in materials and workmanship for a period of six (6) months from date of invoice and will replace or repair without charge at its Oshkosh, Wisc. factory any part or unit which in its opinion is defective when returned to the factory, carriage charges prepaid, within that period. The Universal Motor Company shall in no event be liable for consequential damages or contingent liabilities arising out of the failure of any products or parts to operate properly.

All trade-marked components are warranted separately by their respective manufacturers. On any faulty components returned to the Universal Motor Company, the Universal Service Department will gladly deliver such components to the manufacturer and handle the replacement as directed by the manufacturer.

The right is reserved to change specifications or prices without incurring any responsibility.

UNIVERSAL MOTOR COMPANY - Founded 1898 - OSHKOSH, WISCONSIN

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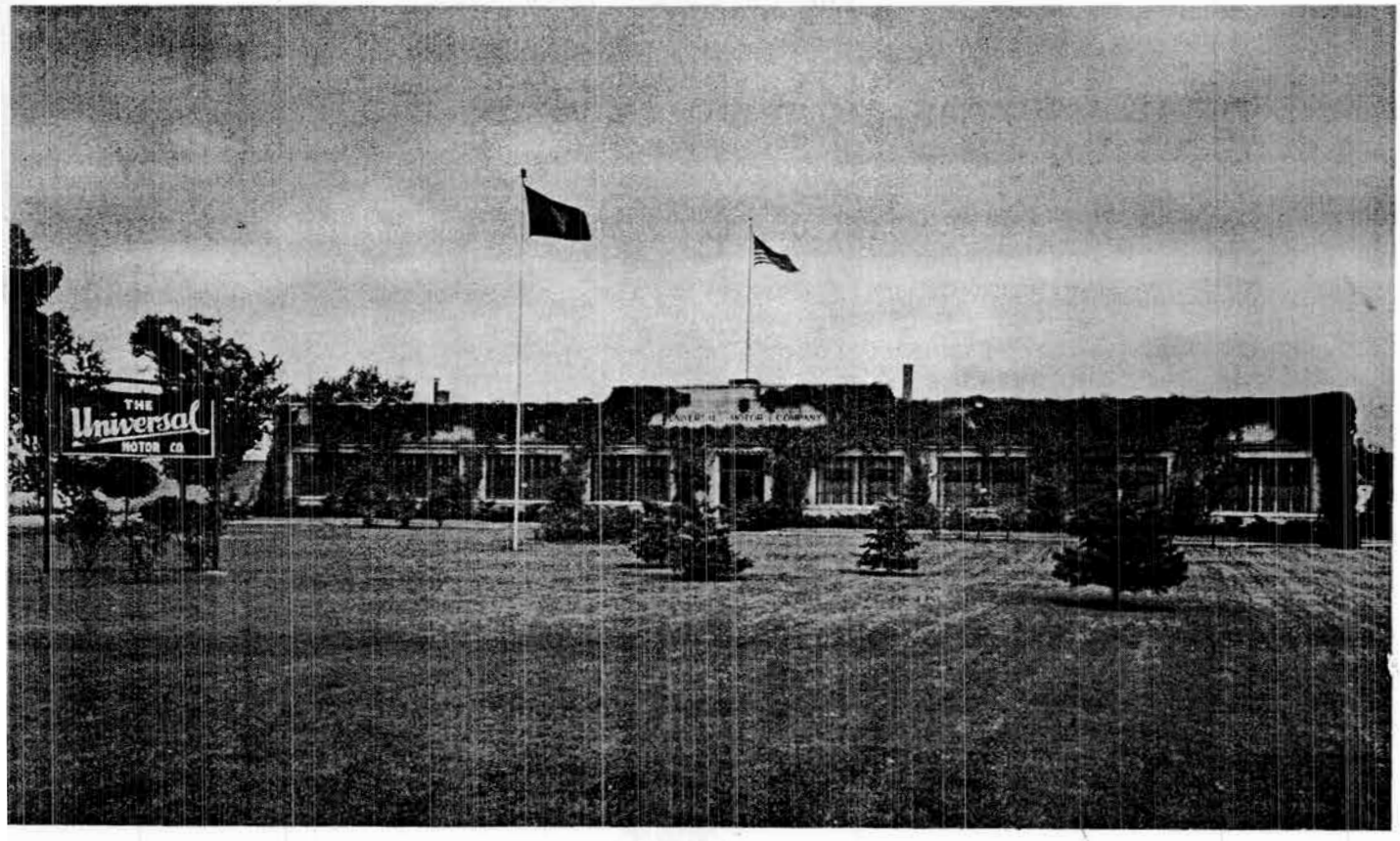
CONGRATULATIONS!

You are now the proud owner of the world's finest marine engine.

Your engine has been built of the best available materials and with the utmost care by the most experienced marine engine craftsmen.

UNIVERSAL's many years of engineering and manufacturing skill have gone into this product.

Please read your maintenance instructions carefully. Proper care will assure you reliable, trouble-free performance for many, many years to come.



THE UNIVERSAL MOTOR COMPANY FACTORY

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SECTION I
GENERAL INFORMATION

1. INTRODUCTION

This instruction book gives general instructions for the installation, operation and maintenance of all current production models of UNIVERSAL and former NORSEMAN models listed on title page. Instructions throughout the book generally pertain to all of the models listed. When specific differences occur, the model or models to which the instructions pertain will be referred to directly.

a. Marine engine requirements differ radically from those of the automobile. This fact was recognized as far back as 1898 when the founders of the Universal Motor Company conceived and built the first 100% marine engine. Through the years, as model after model was designed, exclusively for marine service, improvements and refinements have been continually added. Today Universal is the world's largest builder of 100% Marine Engines.

b. To provide for the more severe service that marine engines encounter in use, Universal has pioneered many advancements. These include larger water jackets, with water supplied to all cylinders in equal quantities and at even temperature; water jacket clean-out plate; corrosion-resistant metals; built-in, not attached, reverse and reduction gears; oil coolers; and gear-type water pumps of non-corroding construction.

c. Universal engines have many exclusive features not found in other marine engines -- features you will come to appreciate more and more as you become familiar and experienced with your Universal. Each one is designed to assure long, dependable and economical service afloat.

d. Every modern facility is employed in building these marine engines. Yet metals will wear, and as time goes on, certain adjustments will be necessary. It is, therefore, the purpose of this book to show you the "why" and "how" of operation and maintenance. A reasonable amount of care will assure your complete satisfaction.

2. FACTORY PREPARATION FOR SHIPMENT

a. Each Universal built engine is run on its own power from idle speed to full throttle. Each is checked for oil leaks, water leaks, oil pressure, and all other conditions which will assure the engine operating satisfactorily when installed. All adjustments are made during test and are undisturbed when the engine is shipped.

b. Run-in lubricating oil is drained from the oil pan, all openings sealed and the engine painted with special marine paint.

c. Special rust preventive oil, drawn into the engine through the spark plug openings, gives a rust resisting coating to valves, pistons and cylinder walls. This prevents corrosion within the engine during shipment and storage.

d. Heavy frame shipping skids and crates insure the customer receiving the engine in excellent condition and ready for installation and operation.

3. TREATMENT OF ENGINE ON ARRIVAL

Before installing a new engine make a complete inspection of the engine for damaged or loose parts. New gaskets tend to compress so it is wise to check all accessible nuts and bolts for tightness. The

is wise to check all accessible nuts and bolts for tightness. The various tags and decals attached to the engine contain important information which should be carefully noted.

4. ENGINE ROTATION

Engines designated as standard rotation use a right hand propeller in all types and gear ratios with only two exceptions, and these are the reduction gear models of the Utility Four and Super-Four series. These two models utilize external type reduction gears which change the rotation and they therefore use left hand propellers. Opposite rotation engines are available in all of the six and eight cylinder series and in every case utilize a left hand propeller.

5. ENGINE IDENTIFICATION

Each engine bears a name plate indicating the engine model designation and the individual engine's serial number. The combination of the model designation and the serial number constitutes positive identification of the engine. It is, therefore, very essential that you use this identification every time you request information about your engine or order parts.

Table 1
GENERAL DATA

	Model	HP	No. of Cyl.	Bore	Stroke	Piston Disp. Cu. In.	Max. Engine RPM	Reduction Gear Ratio	Standard Propeller Rotation	Reversing Gear	Standard Ignition	Standard Coupling
Blue Jacket Twin	AFT	12	2	3"	3-1/2"	49.5	2200	---	R.H.	Manual	Magneto	7/8"
	AFTL	12	2	3"	3-1/2"	49.5	2200	---	R.H.	Manual	6 V. Elec.	7/8"
Atomic Four	UJ	30	4	2-9/16"	3-1/8"	64.46	3500	---	R.H.	Manual	6 V. Elec.	7/8"
	UJR	30	4	2-9/16"	3-1/8"	64.46	3500	2:1	R.H.	Manual	6 V. Elec.	1-1/8"
	UJ-VD	30	4	2-9/16"	3-1/8"	64.46	3500	1:1,1.29:1, 1.67:1,2:1	R.H.	Manual	6 V. Elec.	7/8" & 1"
Utility Four	BN	25	4	2-3/4"	4"	95	2200	---	R.H.	Manual	6 V. Elec.	7/8"
	BNM	25	4	2-3/4"	4"	95	2200	---	R.H.	Manual	Magneto	7/8"
	BNR	25	4	2-3/4"	4"	95	2200	2.28:1	L.H.	Manual	6 V. Elec.	1-1/8"
	BNMR	25	4	2-3/4"	4"	95	2200	2.28:1	L.H.	Manual	Magneto	1-1/8"
Uniwite Four	HF	70	4	3-1/4"	4-1/4"	141	3500	---	R.H.	Manual	6 V. Elec.	1"
	HFR	70	4	3-1/4"	4-1/4"	141	3500	2:1	R.H.	Manual	6 V. Elec.	1-1/4"
	HF-VD	70	4	3-1/4"	4-1/4"	141	3500	1:1,1.29:1 1.67:1,2:1	R.H.	Manual	6 V. Elec.	7/8"& 1"
Super-Four	LSG	55	4	3-1/4"	4-1/2"	149.3	3000	---	R.H.	Manual	6 V. Elec.	1"
	LSGR	55	4	3-1/4"	4-1/2"	149.3	3000	2.28:1	L.H.	Manual	6 V. Elec.	1-3/8"
Arrow MASTER SIX	230	100	6	3-7/16"	4-1/8"	230	3200	---	R.H.	Manual	12 V. Elec.	1"
	231	100	6	3-7/16"	4-1/8"	230	3200	1.88:1	R.H.	Manual	12 V. Elec.	1-1/8"
	232	100	6	3-7/16"	4-1/8"	230	3200	2.44:1	R.H.	Manual	12 V. Elec.	1-1/4"
	233	100	6	3-7/16"	4-1/8"	230	3200	3.32:1	R.H.	Manual	12 V. Elec.	1-3/8"
	234	100	6	3-7/16"	4-1/8"	230	3200	4.12:1	R.H.	Manual	12 V. Elec.	1-1/2"
Bluefin	SY230	113	6	3-7/16"	4-1/8"	230	3500	---	R.H.	Manual	12 V. Elec.	1"
	SY231	113	6	3-7/16"	4-1/8"	230	3500	1.5:1	R.H.	Manual	12 V. Elec.	1-1/8"
	SY232	113	6	3-7/16"	4-1/8"	230	3500	2:1	R.H.	Manual	12 V. Elec.	1-1/4"
	SY230P	113	6	3-7/16"	4-1/8"	230	3500	---	R.H.	Hydraulic	12 V. Elec.	1"
	SY231P	113	6	3-7/16"	4-1/8"	230	3500	1.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/8"
	SY232P	113	6	3-7/16"	4-1/8"	230	3500	2:1	R.H.	Hydraulic	12 V. Elec.	1-1/4"
	VSY230P	113	6	3-7/16"	4-1/8"	230	3500	1:1,1.5:1, 2:1	R.H.	Hydraulic	12 V. Elec.	1 to 1-1/4"
Matlin	320	110	6	4"	4-1/4"	320	2500	---	R.H.	Manual	12 V. Elec.	1-1/8"
	321	110	6	4"	4-1/4"	320	2500	1.88:1	R.H.	Manual	12 V. Elec.	1-1/4"
	322	110	6	4"	4-1/4"	320	2500	2.44:1	R.H.	Manual	12 V. Elec.	1-3/8"
	323	110	6	4"	4-1/4"	320	2500	3.32:1	R.H.	Manual	12 V. Elec.	1-3/4"
	324	110	6	4"	4-1/4"	320	2500	4.12:1	R.H.	Manual	12 V. Elec.	2"
Tarpon	Y330	140	6	4"	4-1/4"	320	3000	---	R.H.	Manual	12 V. Elec.	1-1/8"
	Y330P	140	6	4"	4-1/4"	320	3000	---	R.H.	Hydraulic	12 V. Elec.	1-1/8"
	Y331P	140	6	4"	4-1/4"	320	3000	1.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/4"
	Y332P	140	6	4"	4-1/4"	320	3000	2:1	R.H.	Hydraulic	12 V. Elec.	1-3/8"
	Y333P	140	6	4"	4-1/4"	320	3000	2.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/2"
	330	140	6	4"	4-1/4"	320	3000	---	R.H.	Manual	12 V. Elec.	1-1/4"
	331	140	6	4"	4-1/4"	320	3000	1.88:1	R.H.	Manual	12 V. Elec.	1-3/8"
	332	140	6	4"	4-1/4"	320	3000	2.44:1	R.H.	Manual	12 V. Elec.	1-1/2"
	333	140	6	4"	4-1/4"	320	3000	3.32:1	R.H.	Manual	12 V. Elec.	1-3/4"
	334	140	6	4"	4-1/4"	320	3000	4.12:1	R.H.	Manual	12 V. Elec.	2"
Knight	Y350	165	6	4"	4-1/2"	340	3300	---	R.H.	Manual	12 V. Elec.	1-1/8"
	Y350P	165	6	4"	4-1/2"	340	3300	---	R.H.	Hydraulic	12 V. Elec.	1-1/8"
	Y351P	165	6	4"	4-1/2"	340	3300	1.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/2"
	Y352P	165	6	4"	4-1/2"	340	3300	2:1	R.H.	Hydraulic	12 V. Elec.	1-1/2"
	Y353P	165	6	4"	4-1/2"	340	3300	2.5:1	R.H.	Hydraulic	12 V. Elec.	1-3/4"
	350	165	6	4"	4-1/2"	340	3300	---	R.H.	Manual	12 V. Elec.	1-1/4"
	351	165	6	4"	4-1/2"	340	3300	1.88:1	R.H.	Manual	12 V. Elec.	1-1/2"
	352	165	6	4"	4-1/2"	340	3300	2.44:1	R.H.	Manual	12 V. Elec.	1-3/4"
	353	165	6	4"	4-1/2"	340	3300	3.32:1	R.H.	Manual	12 V. Elec.	2"
	354	165	6	4"	4-1/2"	340	3300	4.12:1	R.H.	Manual	12 V. Elec.	2-1/4"
Little King	LEV	188	V8	3-7/8"	3"	283	4000	---	R.H.	Manual	12 V. Elec.	1"
	LEV15	188	V8	3-7/8"	3"	283	4000	1.5:1	R.H.	Manual	12 V. Elec.	1-1/4"
	LEV20	188	V8	3-7/8"	3"	283	4000	2:1	R.H.	Manual	12 V. Elec.	1-1/4"
	LEV25	188	V8	3-7/8"	3"	283	4000	2.5:1	R.H.	Manual	12 V. Elec.	1-1/4"
	LEVH	188	V8	3-7/8"	3"	283	4000	---	R.H.	Hydraulic	12 V. Elec.	1"
	LEVH15	188	V8	3-7/8"	3"	283	4000	1.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/4"
	LEVH20	188	V8	3-7/8"	3"	283	4000	2:1	R.H.	Hydraulic	12 V. Elec.	1-1/4"
	LEVH25	188	V8	3-7/8"	3"	283	4000	2.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/4"
Big King	NKEV	277	V8	4.3"	3.7"	430	4000	---	R.H.	Hydraulic	12 V. Elec.	1-1/4"
	NKEV25	277	V8	4.3"	3.7"	430	4000	2.5:1	R.H.	Hydraulic	12 V. Elec.	1-1/2"

SECTION II
INSTALLATION

1. PREPARING FOR INSTALLATION

Remember that as much of the work of installing an engine takes place under and around the boat as inside. Provide plenty of room. Remember, too, that the boat and the engine amount to a considerable weight and all blocking must be strong enough to support this weight plus that of the people working in the boat.

As the first step, shore up the boat until the hull is approximately three feet off the floor. For most small boats, a three-point suspension will be sufficient. Blocking should be placed about six feet abaft the bow and at each corner of the transom. This type of blocking will give adequate support and at the same time leave the stern section free of obstruction. On larger boats, extra blocking should be used along the keel.

The next step in the procedure is determining the location and angle of the shaft hole. A number of things must be considered before this can be established. (See Fig.1)

The width of the rudder, size of the propeller, and the clearance between the propeller and the bottom of the boat (minimum 2"). Clearance between the rudder and the propeller should not be less than 4", and room to allow removal of the propeller without first removing the rudder is more satisfactory. It is, of course, also necessary to know the exact location of the engine and the manufacturer's recommended maximum and minimum angles of engine operation.

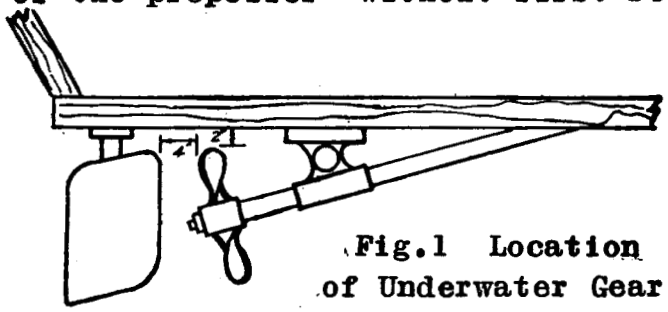

Fig.1 Location of Underwater Gear

If full scale drawings of the boat are available, locating the shaft hole and establishing the angle is simple. It is only necessary to lay down a full-sized profile in some convenient spot and place over this drawing full-size cutouts of the engine, rudder and propeller in their proper places. The cutout for the propeller need only be an oblong of cardboard with the center carefully marked. The length should equal the diameter, and the width, the pitch divided by the number of blades. For example, a 12 x 12 propeller would be represented by a piece 12" long and 4" wide for a three-blade prop and 6" wide for a two-blade. The engine cutout should be a fairly accurate reproduction of the lower half of the engine with the shaft centerline clearly marked. This should be drawn with care on a large piece of paper using the dimensions given on the engine scale drawing.

With the rudder and propeller facsimiles in place and proper clearance accounted for, the cutout of the engine is then moved about until the centerline of the shaft lines up with the centerline of the propeller, and the spot and angle where this line passes through the keel carefully noted. The position of the engine is then carefully checked to be sure there is sufficient clearance between it and the bottom of the boat and that the angle of the engine does not exceed the recommended operating angle (5 to 14 degrees in most engines). The

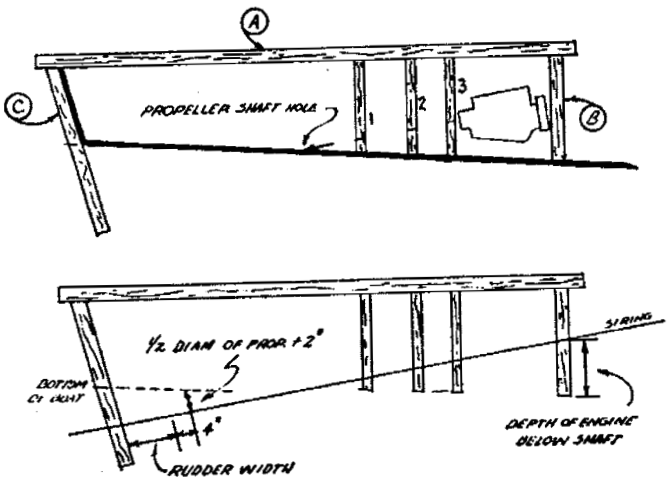

Fig.2 Method of Locating Shaft Hole

engine must be lined up either by raising or lowering it or changing the angle. Do not move the engine fore-or-aft from its previously determined location.

If full scale drawings of the boat are not available, another simple method of locating this spot is to lay a length of 1 x 4 lumber from the center of the transom forward to a spot well beyond the determined engine location.(See Fig.2). Temporarily prop this strip (A) in place so it is roughly parallel to the keel. To this,and at a right angle to it, nail another strip (B) at the point where the flywheel of the engine will be located. Fasten a second strip (C) so that it passes outside the stern, follows the angle of the stern and projects at least three feet below the bottom of the boat. Narrow strips are now fastened to the top strip, approximately every foot along its length and at right angles to it, so that the ends of the sticks just touch the bottom of the boat. This jig, which actually is a full sized pattern of the inside of the boat, can now be removed and laid flat on the floor.

A string is then stretched from the board which represents the transom to the one representing the location of the flywheel. The string is adjusted to obtain proper propeller clearances and crankcase and flywheel clearance for the engine. When the position of the string has been accurately determined, the place it passes each of the sticks is carefully marked and the jig placed back in the boat. It is then a simple matter to lay a straightedge along these marks (1,2,3 on Fig.2) to the bottom of the boat which will give the position and angle of the shaft hole.

2. INSTALLING THE PROPELLER SHAFT

A wedge is now constructed which will fit between the keel and the inboard shaft log. This wedge may be fashioned from any hardwood, but mahogany is recommended since it is

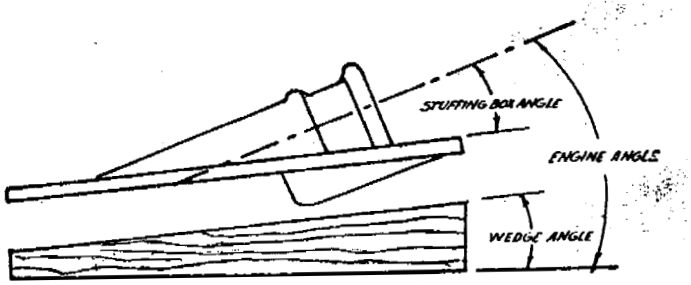

Fig. 3 Shaft Log

easy to work with and is an excellent marine material. This wedge should be as wide and as long as the shaft log to be used and cut at an angle corresponding with the angle of the shaft hole minus the angle of the shaft log. (See Fig.3) The thickness of the wedge will vary with the angle but the thin edge should be approximately 1/2 inch thick. In some cases, the width of wedge may exceed the width of the keel since it must be as wide as the shaft log.

In this event, the underside of the wedge should be shaped to fit the keel and the edges shaped to fit alongside the keel and fit the hull as snugly as possible. The wedge should also be notched out to fit

any ribs which might interfere. The wedge is then screwed into position over the location of the shaft hole. Use a good grade bedding compound between the wedge and the keel and fasten securely to the keel with screws, being careful to place these screws where they will not interfere with the shaft log mounting screws.

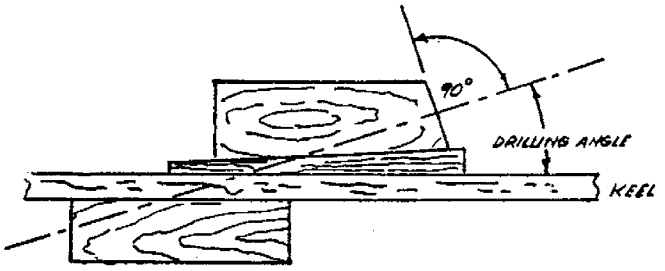

Fig.4 Method of Drilling Shaft Hole

After the wedge is in place, prepare for the drilling of the shaft hole. Preparation for this step consists of the construction of two hardwood blocks which will act as guides in getting the shaft hole started properly and keeping the angle of drilling fairly accurate. These blocks should be of straight-grained hardwood - maple or oak will do. They should be approximately 2" thick, 5" wide and 10" long.

One of these blocks (See Fig. 4 and 5) is fastened to the inside of the boat so that the center of the block lines up approximately with the position of the shaft hole and the other is fastened to the bottom of the boat at the approximate position the hole will emerge. The face of the block fastened to the inside of the boat is cut so as to be at right angles to the drilling angle. In order to keep the drilling angle accurate, a guide block can be fastened 3" to 6" from this starting block. A notch cut in this block to fit the shank of the drill will support the drill at the proper angle. (See Fig. 5)

A drill 1/8 inch larger than the shaft diameter should be used to provide proper clearance. Any type of drill may be used which will drill a clean hole and has a shank long enough to pass through the two blocks and the keel. A standard carpenter's auger is not recommended since the "worm" tends to follow the grain and using it may result in a wandering hole. If a drill cannot be found with a sufficiently long shank, it can be extended by welding on a steel rod. When the drill has passed completely through the keel and the bottom block, it can be removed and the two temporary drilling blocks unscrewed from the boat.

Now lay the shaft log on the wedge and over the shaft hole. In some cases, it will be necessary to chisel out the wedge to conform to the bottom of the shaft log. Make this notch slightly larger than necessary to allow for later alignment. Fashion a gasket from 1/16" rubber or 1/32" gasket material and place it between the shaft log and wedge.

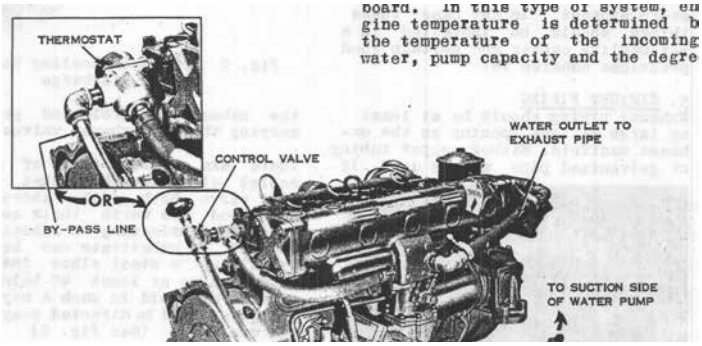

Fig.5 Photo of Drilling Operation

Insert the propeller shaft in the shaft hole and with the shaft log over the hole, position the shaft log so that the propeller shaft is approximately in the center of the hole in the shaft log. Coat both sides of the shaft log gasket with a good marine sealer and fasten the shaft log in place with screws long enough to pass through the wedge and well into the keel.

Next slip the shaft strut over the