CROWELL DESIGNS

Manual for the Installation, Maintenance and Operation

of the

CROWELL HYDRAULIC HELM

Please Leave These Instructions Aboard for the Owner!

Printed in U. S. A.

PRICE $1.00

4th Revision — Printed 1960

SPECIAL INSTRUCTIONS FOR MODEL B HELM UNIT

The installation manual, attached, has been written for the Crowell Model A Helm installation. In general, it also applies to the Model B, with the following exceptions:

SINGLE STATION INSTALLATION — Identical as shown in manual except that:

1. Completed installation, when properly bled, will have only 2¼ turns from hard over to hard over.
2. Rudder stops MUST be installed so that slave travel is stopped ⅛" from end of its stroke.
3. Steering is reversible.
4. Do not pressurize as explained on page 8—lower right hand paragraph (After System Seems Filled)

DUAL STATION INSTALLATION—Same exceptions as for single station except that:

5. Model B piping MUST be in series as shown on attached drawing rather than in parallel as shown in manual for Model A helm. Note that two by-pass valves are required for dual station Model B installation and NO shut off valves.
6. To fill Model B installation by gravity, the same general instructions apply as for the Model A. If a pump is utilized connect the return tubes to the upper station and proceed as though it were a single station. While the pumping is going on, close the by-pass valves and back off the filler plugs on the lower station until all the air escapes as indicated by oil oozing out from around the loose threads. Retighten the filler plugs and stop the pump. Disconnect the hoses from the upper station and "top off" the helm unit with a squirt oil can. Screw in filler plugs securely. Remove hoses from slave unit. Recheck helms for fullness, adding oil if necessary. Only take out one filler plug at a time to avoid loss of oil. Open all by-pass valves, center rudder by hand and turn both helms hard over to starboard and then back 2⅛ turns. Close by-pass valves. Recheck helms for fullness after a day or two of Operation. No air should be in the system if no oil has leaked out. Helms which constantly accumulate air do so because oil is leaking out somewhere. If the hydraulic system is completely full of oil and is oil tight, no air can leak into the system unless oil is leaking out somewhere. Correct any oil leaks. USE NO PIPE DOPE OR PERMATEX on filler plugs or flare connections under any circumstances. It will surely work into the finely machined ball screw parts and cause locking.

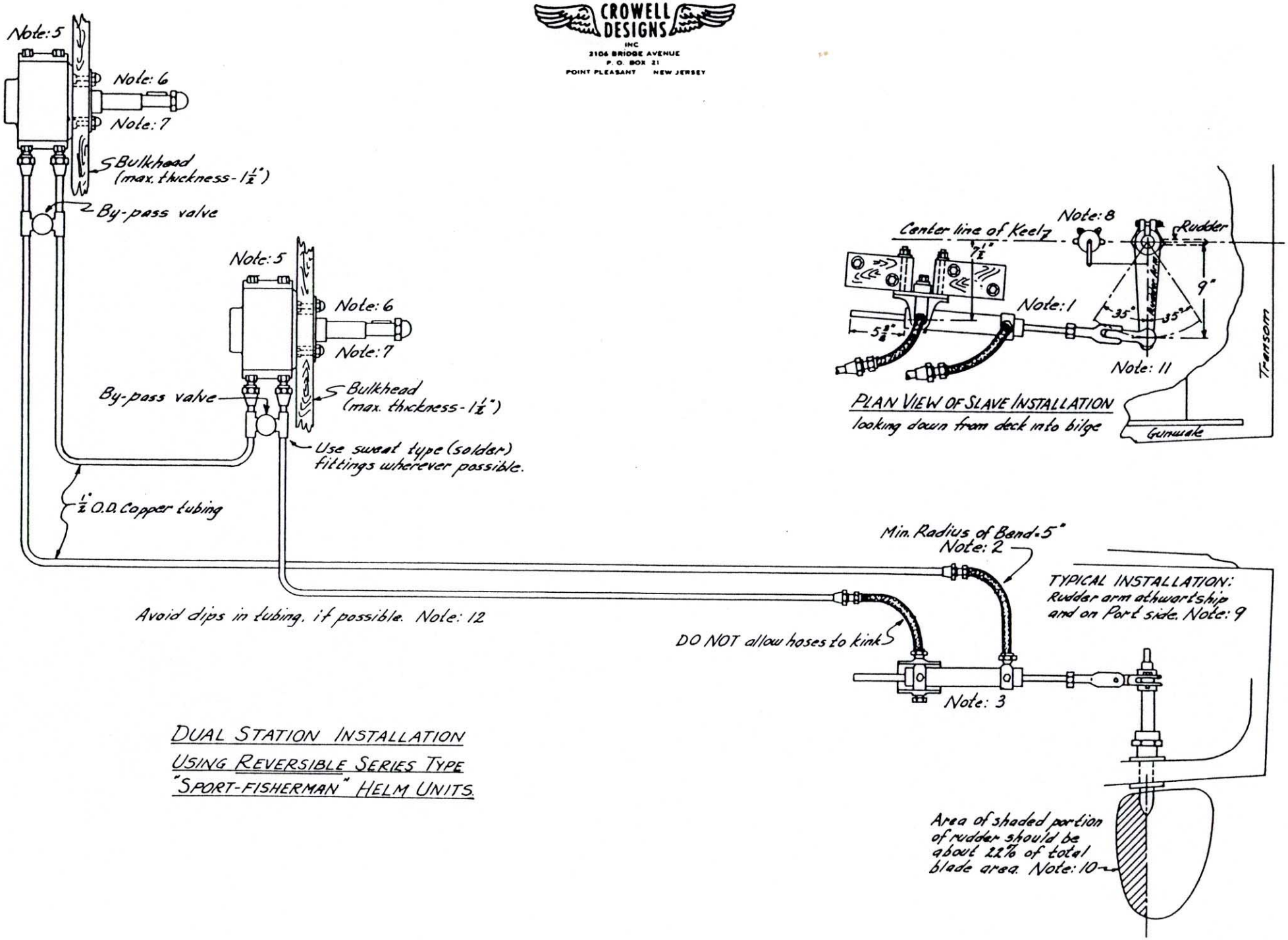
FOREWORD . . . VERY IMPORTANT! ! !

Please read all of the following VERY carefully before further unpacking your Crowell Hydraulic Steering Gear. The time you spend now will be more than repaid by the time you save in installation. When these instructions are well understood by all concerned, the rest is very easy and fast; and, when you have finished, please leave this pamphlet aboard for the owner.

Thank you very much.

CROWELL DESIGNS, Inc.
2106 Bridge Ave.
P. O. Box 21
Point Pleasant, N. J.

CROWELL DESIGNS
INC
2106 BRIDGE AVENUE
P. O. BOX 21
POINT PLEASANT NEW JERSEY



PLAN VIEW OF SLAVE INSTALLATION
looking down from deck into bilge

DUAL STATION INSTALLATION
USING REVERSIBLE SERIES TYPE
"SPORT-FISHERMAN" HELM UNITS

INTRODUCTION

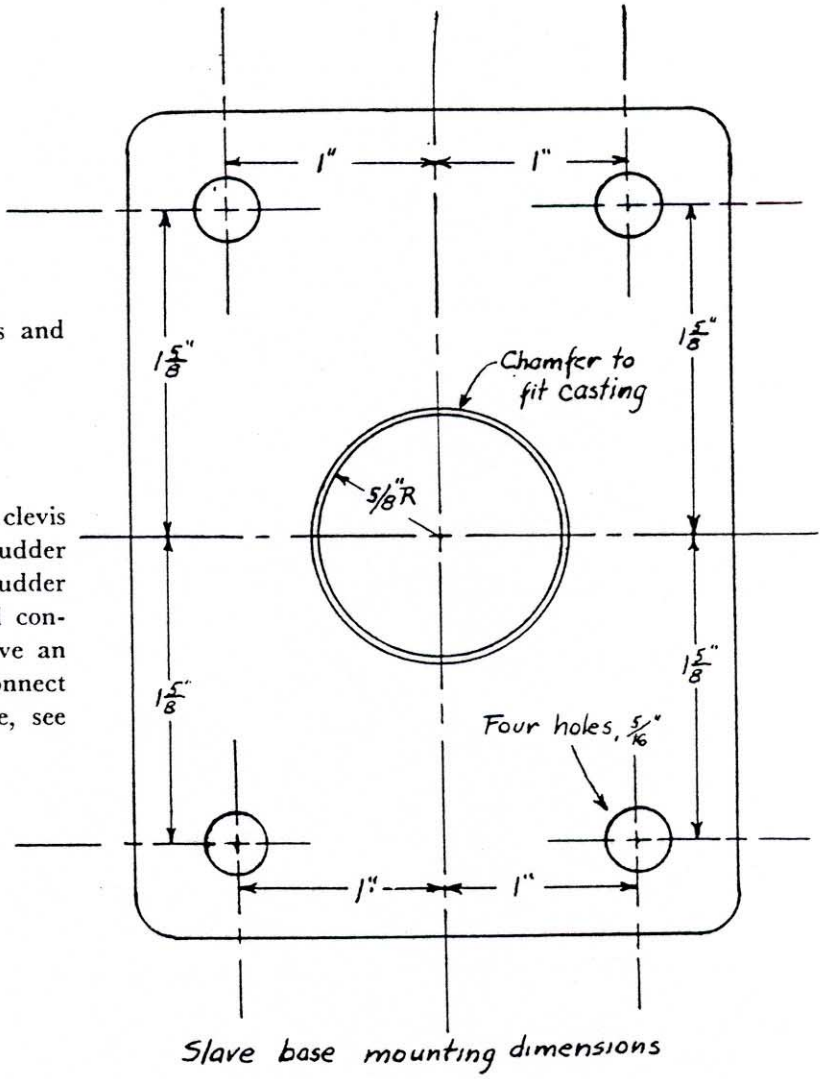
THIS IS A PRECISION DEVICE, and INSTALLATION should not be undertaken until the drawings and instructions have been carefully read, and are fully understood. DO NOT use hydraulic or brake type fluids. The internal seals are for use with **light** oil only, and will be attacked by hydraulic fluid. DO NOT let dirt get into the system. When cutting copper tubing, DO NOT let copper filings fall into tubes. Make sure tubes are absolutely clean internally. Use only clean, fresh oil.

MONEL PISTON ROD (Ref. to notes 1, 2, 3, 8, 9, 10, 11) of the slave unit was hand polished before assembly at our factory. It has been carefully guarded until now. DO NOT mar or score in any manner any portion of the piston rod which passes through the seals. Any scars or roughness will cause eventual failure of the seals.

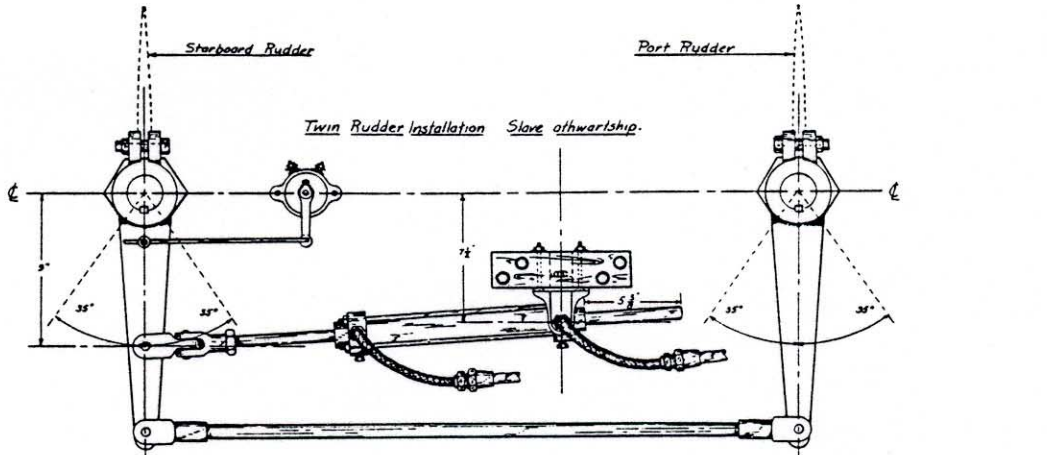
INSTALLING SLAVE UNIT — See drawings and Notes 1, 2, 3, 4, 8, 9, 10, 11, 12.

DUAL RUDDER INSTALLATION

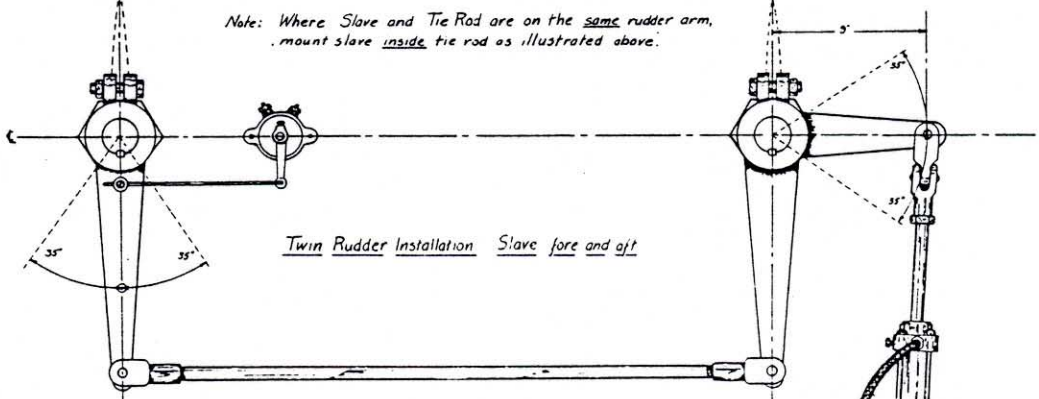
In the case of a dual rudder installation, the clevis of the slave cylinder should be connected to a rudder arm directly mounted on either of the two rudder shafts, rather than to any portion of the tie rod connecting the two rudder arms. Some tie rods have an articulated motion that makes it impossible to connect the slave without loss of mechanical advantage, see notes 1, 8, 9, 10, 11, and drawings on page 2.



Slave base mounting dimensions

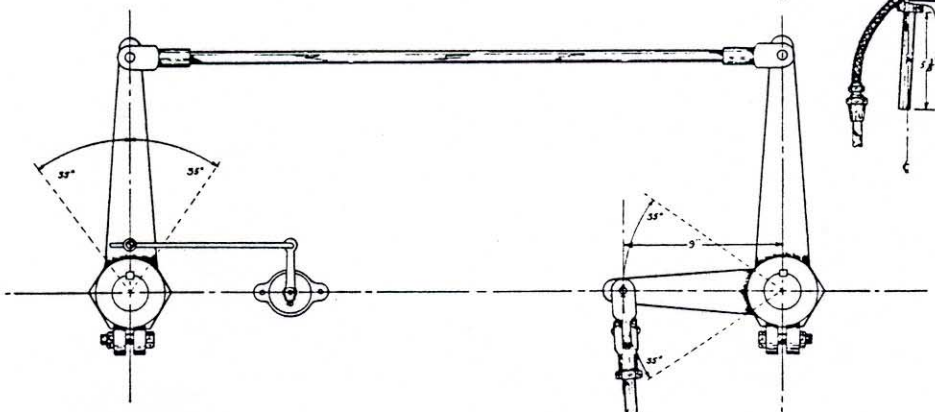


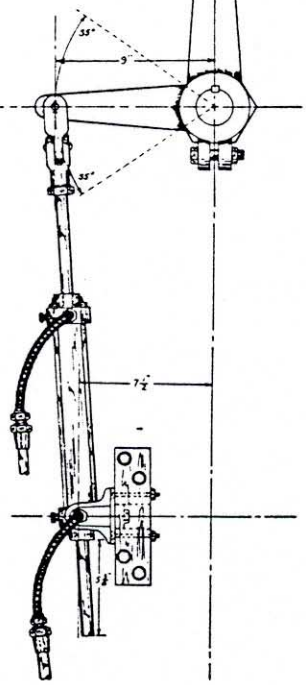
Note: Where Slave and Tie Rod are on the same rudder arm, mount slave inside tie rod as illustrated above.



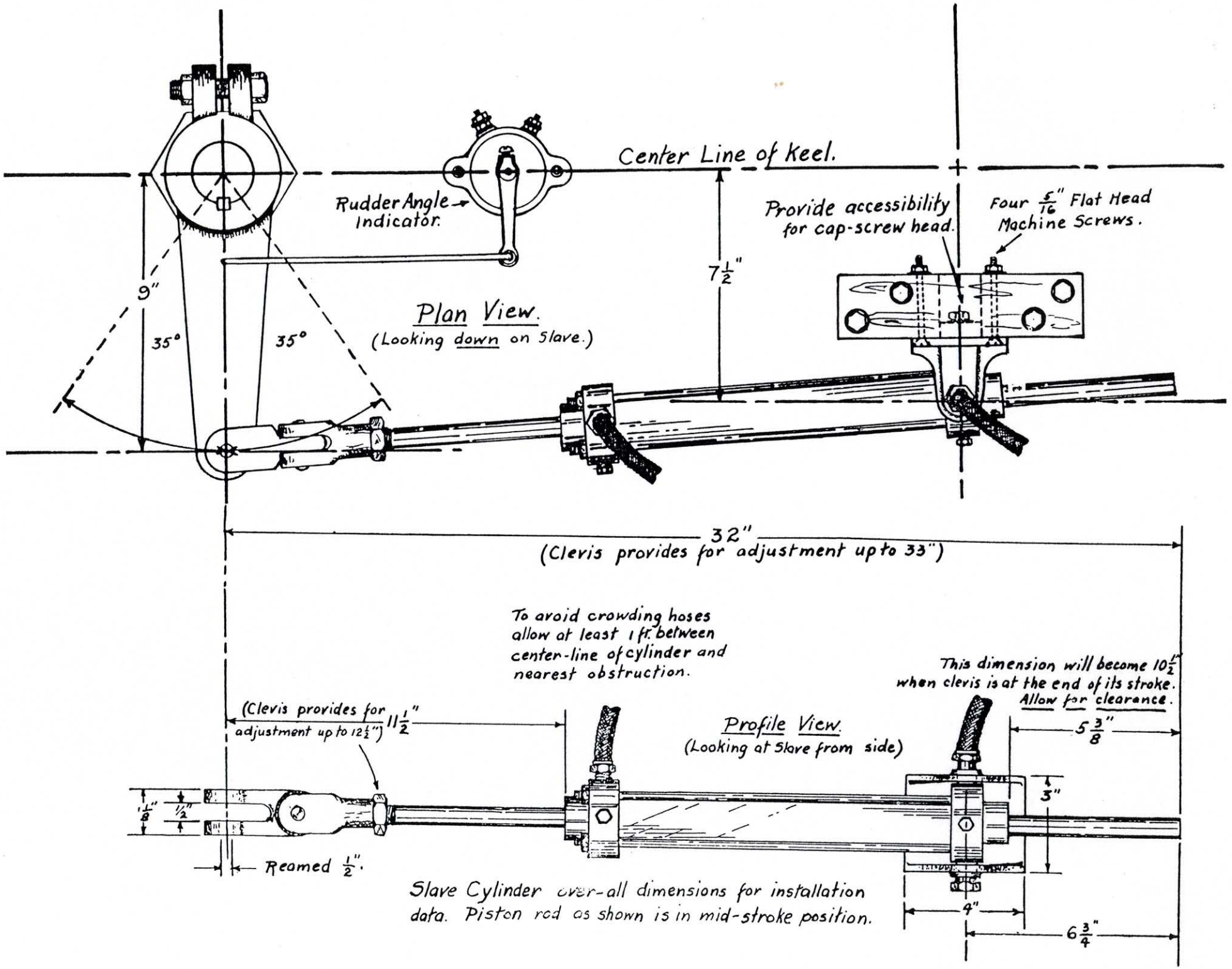
Twin Rudder Installation Slave fore and aft

Note In every installation the pivot of the slave must be closer to the rudder stock center line than the clevis pin by the ratio of 7½" to 9"

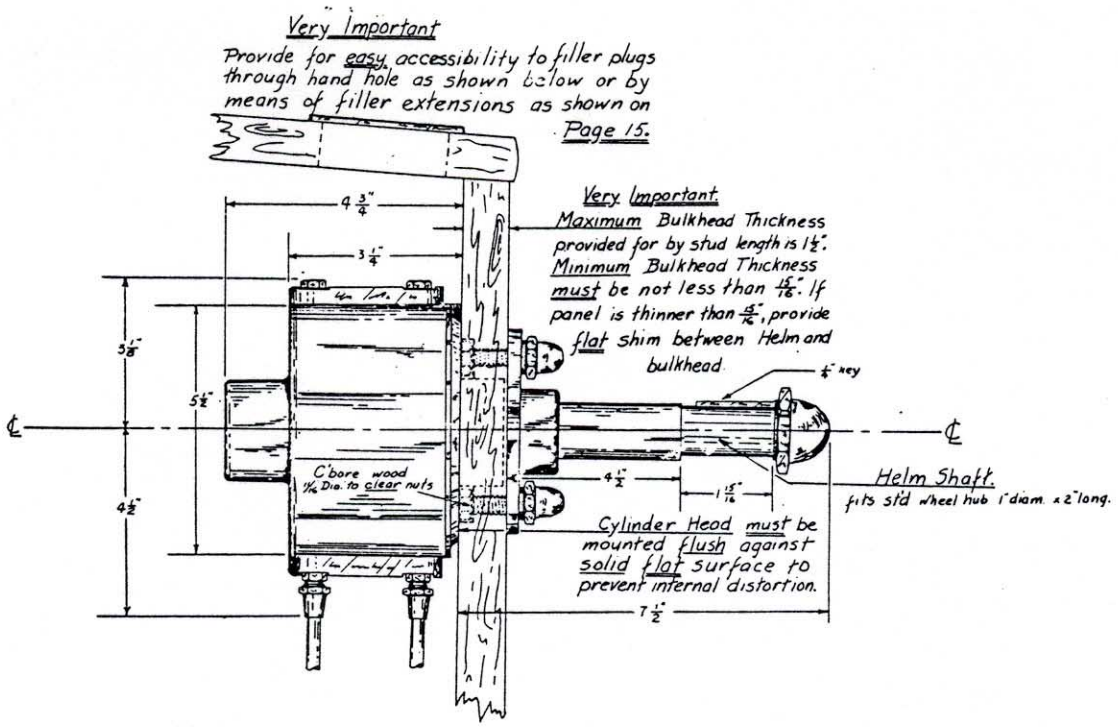




Above are illustrated three different arrangements of the slave cylinder and the rudder arms on a twin rudder boat. There are several other hook-ups that are equally good, but the basic relative positioning of the rudder arm and slave cylinder as shown above, must be retained. For single rudder boats, follow the same general layout.



Slave Cylinder over-all dimensions for installation data. Piston rod as shown is in mid-stroke position.



Helm over-all dimensions for installation data

INSTALLING THE HELM UNIT. (Master Cylinder) (Ref. to notes 5, 6 & 7).

Draw a circle 3" in diameter on the bulkhead with its center at the point where the steering wheel shaft is to project through the bulkhead or control column. Locate four equally spaced points on this circle so that the chords of the arcs connecting them are vertical and horizontal. Counter-bore in the back (forward side) of the panel four holes 11/16" in diameter and 3/8" deep to provide recesses into which the four cylinder head nuts will fit. This is extremely important because the cylinder head must fit firmly against the panel itself which must be flat. If the helm is mounted in any other way, distortion of the cylinder head is bound to result, and hard steering will be inevitable.

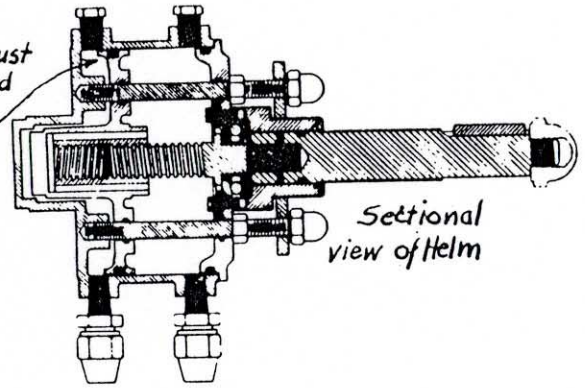
Next, drill on these same centers, four 3/8" or slightly larger holes to admit the cylinder head studs. Cut a hole in the panel 2 1/4" in diameter to accommodate the larger of the two cylinder head hubs. DO NOT UNDER ANY CIRCUMSTANCES mount the helm by the small 1 3/4" diameter hub because subsequent pulling up on the acorn nuts and operational hydraulic pressure will surely damage the helm beyond repair. The chrome plated parts and key can now be removed from the unit and the assembly inserted through the bulkhead from the back with the flare fittings pointing DOWN (important). Replace the escutcheon plate on the front of the panel and draw up the 3/8" acorn nuts snug but not as tight as one would do on engine parts. If the cylinder studs are too long and the acorn nuts bottom internally on the studs, shorten the studs with a hack-saw without removing, turning or loosening them **or provide spacer as mentioned in next paragraph. When assembled in the factory these studs are very accurately positioned and the cylinder head nuts securing them are carefully adjusted with a torque wrench (7 foot-pound setting). Removal of the studs will surely result in very difficult reassembly with probable damage to the seals.**

In installations where the bulkhead panel is less than 15/16" thick it is absolutely necessary to build up its thickness by inserting a spacer between the bulkhead and the helm. This spacer must be flat. Make sure that the combined thickness of spacer and bulkhead panel is at least 15/16" and not more than 1 1/2". Double check to make sure that when the escutcheon plate is pulled up it will not bear against any part of the 2 1/4" diameter hub.

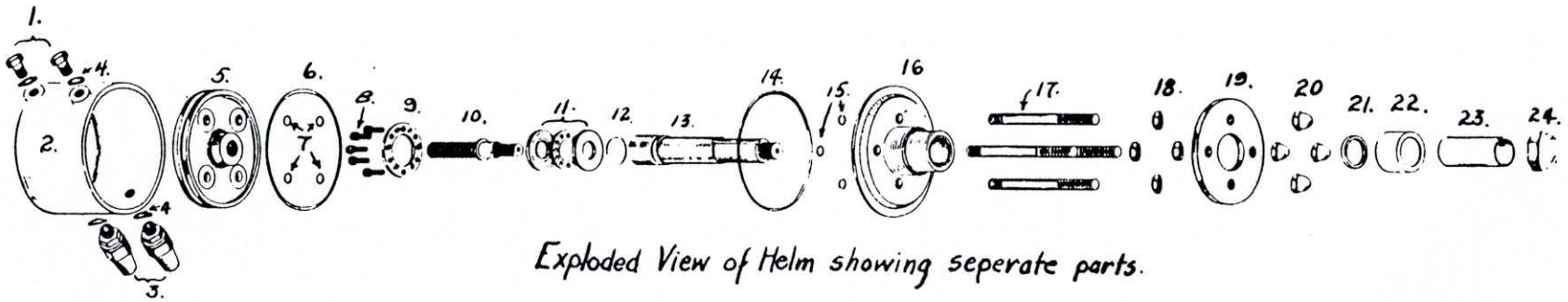
If the bulkhead panel is too thick, counter-sink the escutcheon plate into the aft side of it, (side nearest the wheel). Counter-sinking the forward side of the bulkhead will probably result in an uneven surface. We repeat—the cylinder head MUST be flush against a perfectly flat surface.

Install the steering wheel, key, and remaining parts.

We cannot over-emphasize the importance of following the above instructions carefully—to the letter.



1. Filler plugs (2 req.)
2. Cylinder
3. S.A.E. Adapters
4. Fiber washers (4 req.)
5. Piston
6. Piston "O" Ring
7. Stud "O" Ring (4 req.)
8. Retainer screws (12 req.)
9. Retainer
10. Worm
11. Thrust Bearing
12. Helm Shaft "O" Ring
13. Helm Shaft
14. Cylinder Head "O" Ring
15. Stud "O" Rings (4 req.)
16. Cylinder Head
17. Studs (4 req.)
18. Stud Nuts (4 req.)
19. Escutcheon Plate
20. Stud Acorn Nuts (4 req.)
21. Felt Oil Wick
22. Chrome Cup
23. Chrome Sleeve
24. Shaft Acorn Nut



Exploded View of Helm showing seperate parts.

Figure 6.

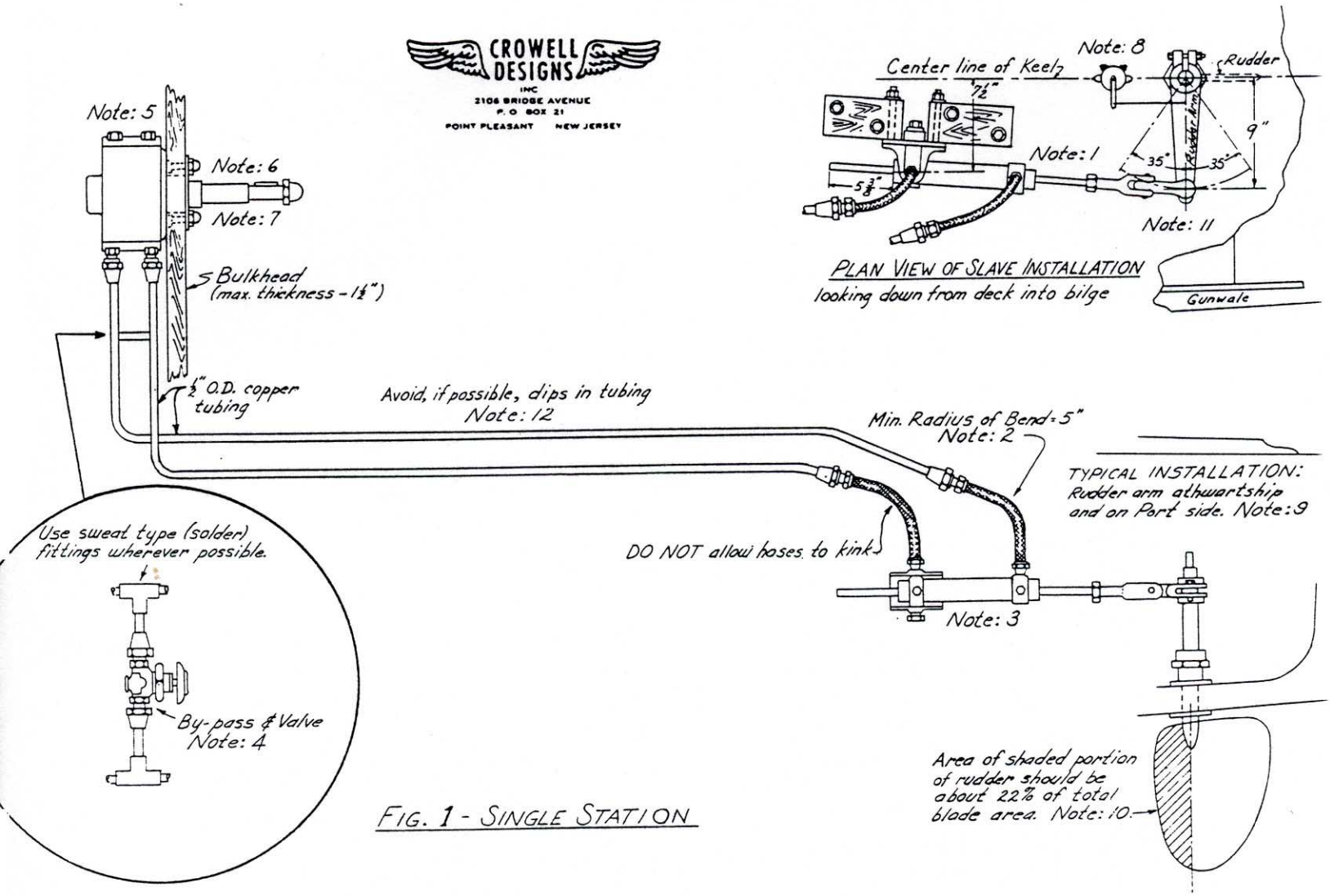


FIG. 1 - SINGLE STATION

INSTALLING TUBING (Ref. to notes 2, 4, 12).

Follow, in general, appropriate diagram.

Use minimum ⅜" I.D. or ½" O.D. soft copper tubing. DO NOT forget to make provisions for the tees, by-pass valve, and for shut-off valves where indicated. Forged fittings are preferable. In order to determine which way the rudder will turn when the steering wheel is rotated to starboard, i.e., clockwise facing the bow, remember that the piston of the master cylinder will move toward you and generate pressure in the end of the master cylinder nearest you as the wheel is turned to the right. Of course, turning the wheel to the left produces pressure in the forward end of the master cylinder. Make sure all oil lines are securely fastened down to prevent their vibration and crystallization.

CROWELL DESIGNS
INC
2106 BRIDGE AVENUE
P. O. BOX 21
POINT PLEASANT NEW JERSEY

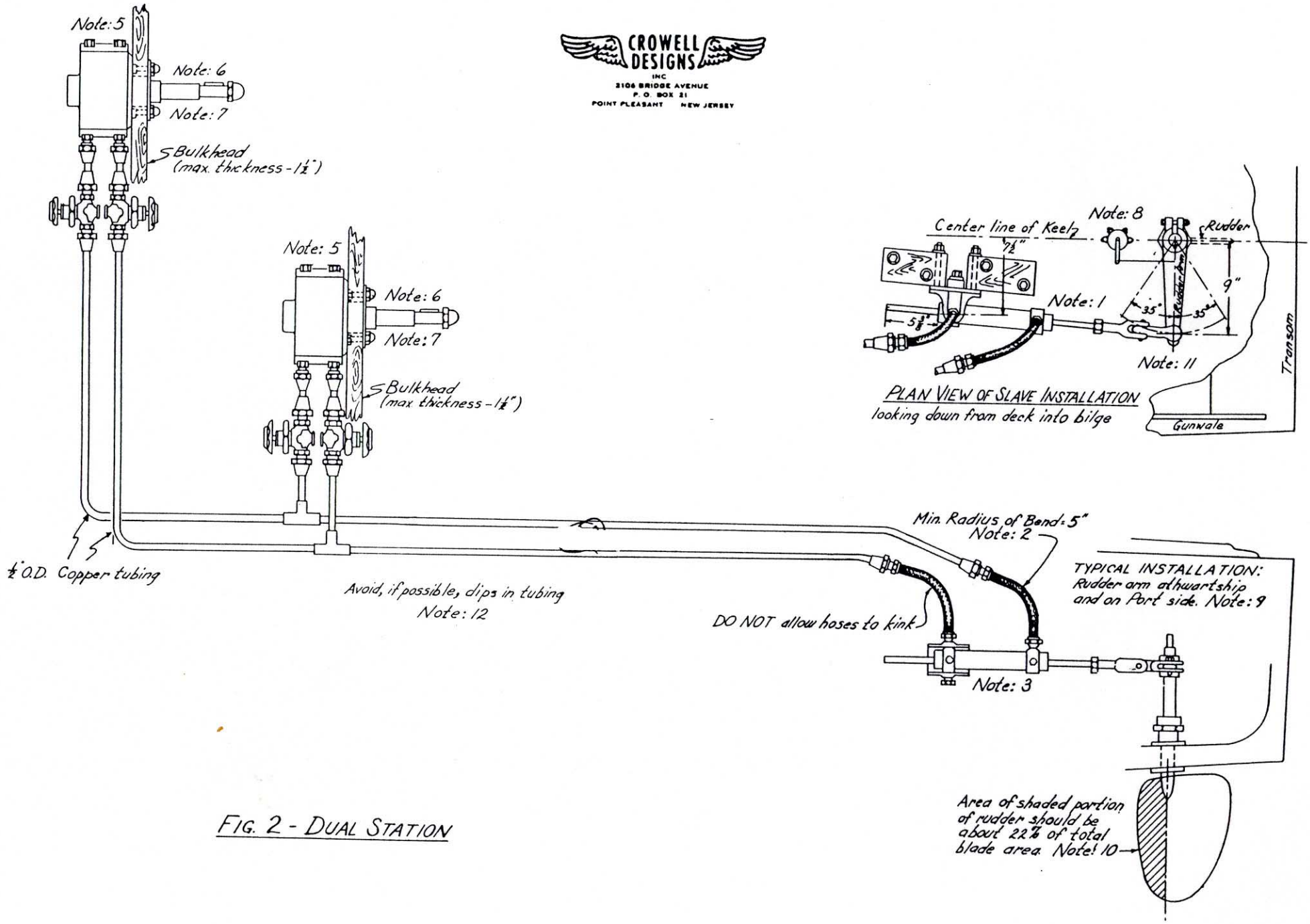


FIG. 2 - DUAL STATION

FILLING THE SYSTEM-Single Station (Ref. to notes 3, 4, 5, 6, 12, & Figure 4)

BEST METHOD:—In boat yards where a small electrically driven positive displacement oil pump is available such as is commonly employed for pumping out crankcases, etc., the easiest and by far the quickest method for filling the system is to use such a pump. The Crowell Model BPI is ideally suited for this purpose. Install a shut off valve on each side of the pump. MAKE SURE PUMP AND VALVES ARE ABSOLUTELY CLEAN!!! Make sure that the gland leaks no oil. Put about six quarts of # 5 or # 10 S.A.E. good quality engine oil in a CLEAN pail. If available oils such as Shell Turbo Oil, transformer oil or type A transmission fluid is excellent and at very low viscosity. Connect the discharge side of the pump to the ⅛" N.P.T. plug on one end of the slave cylinder. Push the slave cylinder piston rod as far as it will go so that the maximum amount of piston rod is exposed on the end of the slave cylinder to which the discharge from the oil pump is connected. This is to reduce by as much as possible he air space in that end of the cylinder. Turn the helm as far as it will go to the left (counter-clockwise). Close the by-pass valve. Trace the oil line leading from the end of the slave cylinder you are charging to determine to which end of the helm it leads. Remove the plug which is in that end of the helm and connect a rubber hose from there long enough to return to the pail.

The helm is tapped for 9/16x18 National fine thread. This is NOT a pipe thread. Keep the discharge from this hose always immersed in the oil in the pail. Turn on the pump and continue to pump until no air bubbles are apparent in the oil being discharged into the pail. If the slave cylinder piston rod has not moved to the opposite end of the slave cylinder, place your finger over the end of the discharge hose to create enough back pressure to force it over. Continue to pump a minute or two more. Turn off pump and close the pump suction line cock. Remove hose connected to master cylinder top fitting. Replace plug immediately, and connect hose to other fitting in top of helm. Remove pressure hose from pump to slave cylinder. Plug immediately. Connect pump pressure hose to other end of slave cylinder. Open shut-off cock on pump suction hose. Turn on pump and repeat above procedure. Turn off pump and close pump suction shut-off cock. Remove discharge hose from master cylinder and plug latter immediately. Remove pressure hose from slave cylinder and replace plug immediately.

FILLING THE SYSTEM—Dual Station

BEST METHOD:—Study the procedure for filling single stations and turn both helms to the left as far as they will go. All helm shut-off valves must remain open, by-pass closed. Fill the side of the lower station helm as shown in Figure #4. If the tubing leading to the second and upper station has a comparatively direct run with no downward loops in it, the second station may be completely filled by removing the plug while oil is circulating through the lower station. If the second station is quite high, it may be necessary to put a little pressure against the pump by thumbing the discharge hose so that the oil will be forced upward and eventually overflow at the filler plug which was removed. Replace plug as soon as oil reaches top of helm overflow.

Now fill the other half of the lower station as described in "Filling the System-Single Station". Fill the other side of the upper helm in the same way described in the preceding paragraph.

If the piping leading to the upper station has loops, dips, or traps in it, fill the lower station first, both sides, as explained in "Single Station" and Figure #4, and then proceed to fill the upper station as though it was a new single station.

ALTERNATE METHOD OF FILLING SINGLE AND DUAL SYSTEMS without a pump.

It is possible to fill both single and dual systems by pouring oil into the helms and letting it trickle down into the rest of the system by gravity. However, if there are dips and traps in the oil lines between the slave and the helms it is very difficult and time consuming to get rid of all the air and it is best to employ a pump. If no pump is available it will help to get rid of the air if the slave cylinder piston rod is moved in and out while the by-pass is open. It will also help to spin the helm from hard over to hard over with the by-pass open. Thumb one filler plug hole then the other to prevent oil slopping out. Leave the helm alone from time to time to allow air to work its way up. If possible, sandwich this work in between other jobs.

AFTER SYSTEM SEEMS FILLED, open by-pass valve. Put rudder in dead ahead position. Turn the steering wheel from hard over to hard over and then half way back. Close by-pass valve. To reduce lost motion to a minimum and eliminate any air in the system, turn the wheel several times from hard over to hard over and stop with the wheel all the way over to the left. Hold about twenty pounds pressure on the wheel toward the left and cautiously remove the 9/16" Hex plug on the end of the master cylinder nearest the wheel. If any air space is revealed, fill with additional oil using a small funnel or syringe (must be clean!). Continue to hold pressure on the wheel while replacing the Hex plug. Repeat the procedure on the other end of the master cylinder; but turn the wheel all the way to the right instead of to the left. If possible add oil into the front fitting on top of the master cylinder head. Replace plug, all the while holding pressure on the helm. The system should now be "zeroed" again by opening the by-pass as outlined at the beginning of this paragraph. If all the foregoing has been followed carefully, the system will now operate satisfactorily.

CAPACITY in pounds of thrust throughout its 10¼" stroke: Normal, 250 lbs. Maximum, 700 lbs. For double capacity use dual slave units.

CROWELL DESIGNS
INC
3106 BRIDGE AVENUE
P O BOX 21
POINT PLEASANT NEW JERSEY

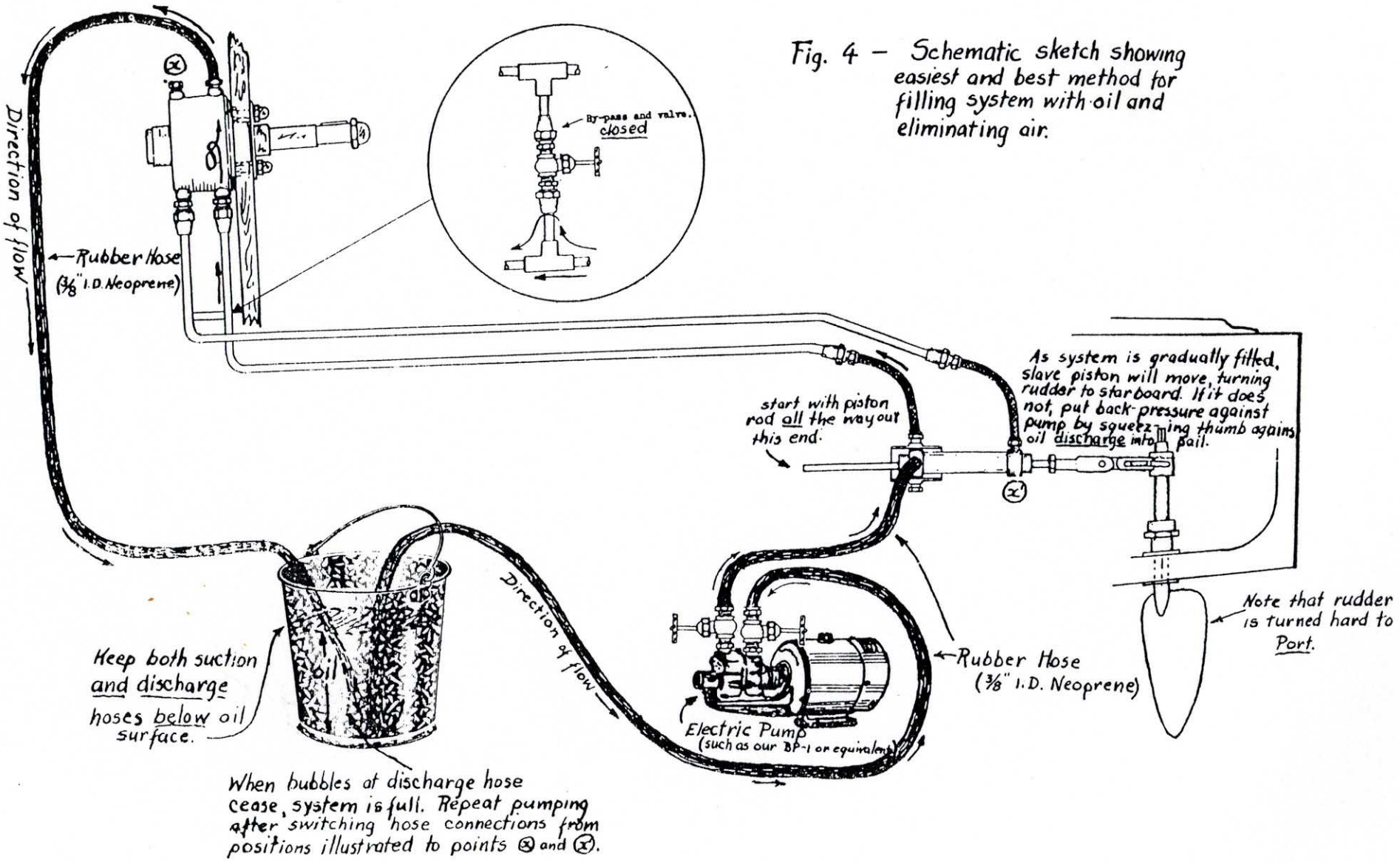


Fig. 4 – Schematic sketch showing easiest and best method for filling system with oil and eliminating air.

AUTOMATIC PILOT INSTALLATIONS

See Figure #3 for automatic pilot installations. The illustration shows our extended helm shaft which is available on special order. The purpose of the long shaft is to make possible mounting the chain and the sprocket for the automatic pilot ahead of the bulkhead on which the helm unit is mounted so that the chain will be out of sight and will not constitute a hazard. It will not be necessary to use the special long shaft helm if the chain can be mounted on the helm shaft between the aft side of the bulkhead and the steering wheel but in this case some sort of cover should certainly be used as a safety precaution.

All types of automatic pilots will work with the Crowell hydraulic steering system when coupled directly to the helm shaft. Where it is desired to incorporate dual station steering with an automatic pilot, the automatic pilot should be attached to the helm most frequently used.

CAUTION: Always make sure the boat is going straight ahead when going from or onto automatic pilot steering. This is especially important to observe on dual station installations when the manual station being used is not the same station to which the automatic pilot is coupled. Failure to observe this simple rule on dual station installations will result in the two helms getting out of synchronization.

IMPORTANT: All automatic pilot installations MUST be safeguarded by proper fusing and/or slip clutch arrangement.

VERY IMPORTANT: Where automatic pilots are connected to helm units by means of chain and sprocket as illustrated on page 11, the sprocket on the helm shaft should not be smaller than 10" in diameter due to the very heavy tension loads that small sprockets entail. If the boat requires more than 25 foot-pounds of force on the helm in normal straight on-course steering, use of even larger sprocket is advisable.

Re-zero all stations daily until you are sure that you completely understand the technique of changing over from one station to another or the change-over from manual to automatic pilot and vice-versa. DO NOT change steering stations or go on automatic pilot unless the boat is on a straight course except in the case of an emergency. If such an emergency does come up, be sure to re-zero the helms at the earliest safe opportunity. More than 100% over-travel has been provided in the helm design to take care of just such an emergency, but in order to retain this safety factor, the proper relationship of helm and slave should be restored as soon as practicable. Refer to "Zeroing the System", page 14. After the helmsman becomes thoroughly familiar with the change station technique, it should not be necessary to zero the helm except as a precautionary measure from time to time, say once a month.

CROWELL DESIGNS
INC
2106 BRIDGE AVENUE
P O BOX 21
POINT PLEASANT NEW JERSEY

NOTE: When it is not practicable to fill single or dual installations by the gravity method due to the probability of air being trapped somewhere in the system use pump method as shown in Fig. 4 and described in the text. Fill lowest station first, then next higher, then highest.

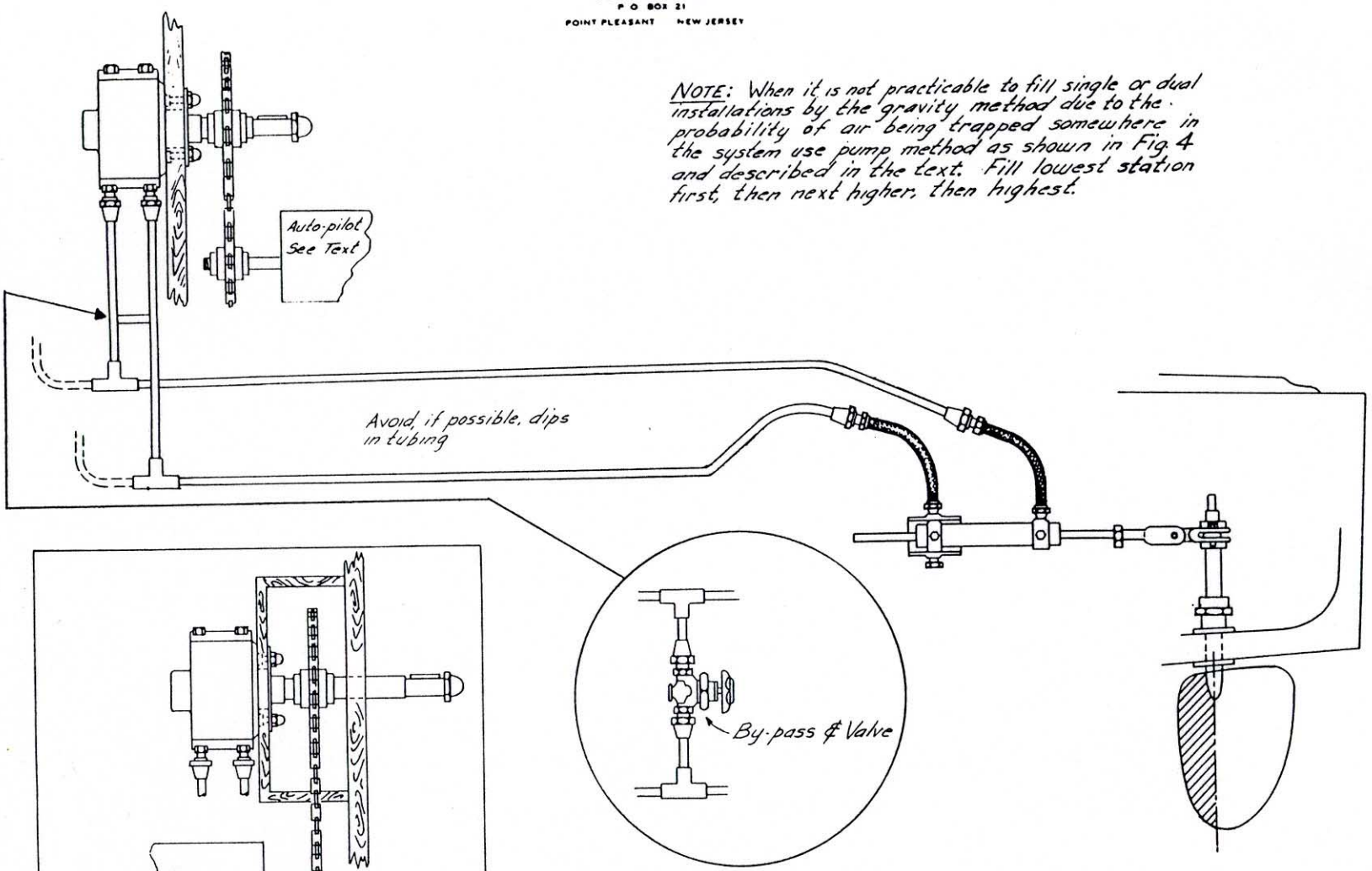


FIG. 3 - SINGLE STATION WITH AUTOMATIC PILOT

For dual station with automatic pilot combine this schematic with FIG. 2.

Optional mounting of helm unit with auto-pilot using "long shaft" helm available on special order.

THE FOLLOWING NOTES REFER TO FIGURES No. 1 and No. 2 on pages 6 and 7

Note: 1.

The slave cylinder has a total stroke of 10¼". Note that when the clevis end is extended to its maximum length there is a short (¼" - ½") portion of the piston rod still protruding from the rear (pivot end) of the cylinder. Follow dimensions shown on drawing very accurately, and install slave so that 5⅛" plus the short (¼" - ½") portion extends from rear when clevis is attached to rudder arm, and rudder is dead ahead. Minor final adjustments may be made by adjusting clevis on its thread. Lock securely with locknut after installation is complete.

The 9" rudder arm, as illustrated, provides for 35° of rudder either side of dead ahead. Maximum turning effect of the rudder does not increase when the rudder angle exceeds approximately 38°. Steering ease becomes disproportionately difficult as the rudder angle increases above 35°. Most properly designed twin-engine boats will not need more than 35° either side of dead ahead, and many use as little as 25°.

NO VESSEL should use over 40°, and when more is apparently needed, rudder design should be verified, as it is better to correct the trouble at its source than to try to overcome improper design with excessive steering angle. This holds true, regardless of the type of steering mechanism.

For Guidance.

Rudder Arm Length	Maximum Rudder Angle
8"	40°
8½"	37½°
9"	35°
9½"	32½°
10¼"	30°

IMPORTANT — DO NOT hammer on any part of the system. This is a precision steering system with internal tolerances of 1-2 ten thousandths of an inch, and hammering on various parts can deform internal surfaces and cause binding. Drill all mounting holes so that studs and mounting bolts slip in snugly, but without having to hammer on unit. In drilling the rudder arm, we recommend that you use a 15/32" drill first and then ream to ½". A sloppy hole here will, of course, increase lost motion at the helm. It is best to mount slave swivel plate first, drilling a 1¼" hole in the center, so that after the plate is bolted down, the swivel and slave can be simply bolted to it. We advise that the swivel plate should fit the hole snugly, thus relieving thrust strains from the hold-down bolts. However, DO NOT DRIVE the plate into the hole because hammering will surely distort the machined surface on which the slave swivels. Make sure that the board to which the swivel plate is bolted is flat. Pull up the ⅜" cap screw which holds the slave saddle to the plate snugly. Tolerance has been allowed so that tightening this screw will not cause binding of the swivel. Slave can be mounted either fore and aft or athwartship, but all dimensions must be held in their relative positions. On smaller boats (under 33'), or on larger boats having light rudder pressures, it is practical to install slave unit so that fewer than 4 turns are required from hard over to hard over. This may be accomplished by shortening the tiller arm to give the required rudder travel, and the installation of rudder stops. The shorter the tiller arm, the more important is proper rudder balance.

Note: 2.

Note hoses attached to slave cylinder. The slave and piping should be installed so that the MINIMUM radius of bend of the hoses is 5". Keep the bend radius as large as possible; and such bending as is necessary should be in the middle of the hose; NOT at one end. If hoses are close to exhaust pipes, protect with fireproof boot or metal baffle, well insulated.

Note: 3.

Whenever possible, mount slave with hoses facing up to allow for bleeding system. ANY OTHER position will trap air in slave and make system practically impossible to bleed.

Note: 4.

Use sweat type fittings wherever possible. Use S.A.E. double flare or flare type at all other connections. In other than new boats be very wary of using a blow torch due to the additional hazard of fuels being present. A by-pass valve MUST be installed in every installation. Although use of this valve will be very infrequent, or not at all after the original filling and bleeding, we recommend that it be placed in an accessible place. On other than the single station installation, we recommend that the by-pass valve be located above decks, convenient to the helmsman at the station most frequently used. A door in the control box makes a very neat, convenient installation. SHUT-OFF VALVES, as shown on Dual station Figure #2 and auto pilot Figure #3 are a matter of personal preference, and should be discussed with boat owner before deciding whether or not to install. From the standpoint of our experience we recommend that they be installed wherever shown on the drawings. While the installation of these valves has nothing to do with the operation of the system and dual station helms will work without the valves or with the valves open, it is strongly recommended that the helm NOT being used be valved off to prevent children or others from tampering with the wheel not being used and also accidental movement of the helm by someone leaning against it, etc. Any movement of either wheel when not valved off will, of course, alter the course of the boat. While one valve at either station will provide a lock, the addition of the second valve at each station will provide a more positive lock and also eliminate the "play" of the station not in use from being felt at the station being used. If the fly-bridge of a dual station boat has to be removed to facilitate overland transportation, double valves at each station will simplify reassembly.

Access to the shut-off valves should be provided by a door directly below the steering station; or, by means of long stem valves, the handles can be brought directly through the bulkhead. The complete valve assembly can be made up of sweated fittings, and tested before installation. An inconvenient location for shut-off valves is neither desirable nor necessary, and discourages their use. We recommend diaphragm type valves such as are manufactured by "Kerotest" (model No. R2404, ½" flare type; No. R2404S, ½" sweat type) and "Imperial" (model No. 493-C ½" flare type; No. 493-CS, ½" sweat type.)

Note: 5.

These plugs must be used for filling and bleeding. Allow provisions for easy accessibility to filling plugs. The best method is to provide a small (2"x4") removable chrome plate, directly above helm. If this is not possible, allow for accessibility from directly behind; with at least 8" between top of plugs and bottom of nearest obstruction to allow for easy filling. Another easy solution is to provide sufficiently long connections of the instrument group so that the entire panel may be lifted high enough to allow sufficient working space to get at the helm without disconnecting any wiring, etc. We have also seen neat installations of the compass which could be readily removed so that accessibility to the helm filler plugs was convenient. When the above methods are impossible, special fittings can be purchased from our factory. Refer to page 15 for drawnigs and catalogue numbers of available accessories.

Note: 6.

Never install helm with inlets and outlets in any but the vertical plane. If the helm is in other than the horizontal plane, the original filling and bleeding is slightly more difficult, but readily accomplished when instructions are followed carefully. If the helm shaft is tipped as in an automobile steering column, before filling the system, turn wheel left (counter-clockwise) as far as it will go. This moves the internal piston fully forward, and minimizes the air chamber in the forward section. Trace the oil line leading from this forward section back to the slave unit to determine if pressure at this end of the helm will turn the rudder to port. When the helm shaft is more than 30° from the horizontal, we suggest that two lengths of high pressure hose (which we can supply) with ½" male flare fitting at one end and ½" female fitting at the other end be installed at the helm outlet so that the complete helm unit can be held horizontal while filling and bleeding, then easily re-installed. Where difficulty is encountered in eliminating trapped air in helms, we recommend the installation of riser assemblies as shown on page 15. Risers are not only a great convenience, but they provide for the necessary high point for filling the system.

Note: 7.

Small chrome acorn nuts are provided on the four studs which hold the helm assembly together. These four studs are carefully locked into position at the factory, and neither the studs nor lock nuts must be tampered with, as they have been set by torque wrench to provide for minimum internal friction. Loosening them can cause helm to leak. Tightening them can cause distortion and excessively stiff operation and in extreme cases, it could deform the housing cover.

Note: 8.

We would like to call your attention to our Rudder Angle Indicator, use of which we strongly recommend on any boat having dual station steering and/or automatic pilot. It is equally advantageous for all types of steering mechanisms, such as wire rope, rods and levers, and hydraulic. On single station installations, it so greatly adds to the ease and safety of maneuvering in close quarters we feel that it is well worth its low price.

Note: 9.

Regardless of whether a steering system is hydraulic, cable, rod, etc., good marine practice dictates a squared off rudder post with provisions for a jury tiller.

Note: 10.

It would be impossible to steer a modern airplane without rudder balance, yet many boats today either lack balance completely, or have an insufficient amount. The spade shape rudder shown should have approximately 22% of blade area forward of the rudder stock in a single engine — single rudder boat or twin-engine — twin rudder boat. A rectangular rudder, or a twin-engine — single rudder boat will usually need more, with some needing as much as 35% forward of the rudder post. This can only be determined upon experiment, but the time spent will be well repaid in a better handling, quicker responding, easier steering boat. A ship with properly balanced rudder or rudders will steer almost as easily into a tight, high speed turn as it will steer when standing dockside. If a boat steers easily into a sharp turn, but is difficult to bring out, there is too much rudder balance and this should be corrected.

Note: 11.

Boats with a combined rudder area in excess of five square feet, or heavy duty work boats subjected to hard service in reverse, should install solid rudder stops, carefully adjusted to engage the rudder arm at the same instant as the slave unit reaches the end of its travel.

Note: 12.

Dips in tubing trap air and make for "spongy" steering or difficult bleeding. Avoid wherever possible. Never KINK tubing. If sharp bends are necessary, use sweat solder els. Fasten the tubing securely and at frequent intervals to avoid abrasion and crystallization. Install tubing as early as possible during boat construction so as to be able to use long sections of tubing — thereby eliminating many connections and bends which could be a possible source of leaks and difficulty in bleeding.

MAINTENANCE

Once a month drip a little clean engine oil on the exposed areas of the slave piston rod, clevis, and pivot. At the same time, squirt a few drops of oil on the helm shaft between the chrome sleeve and chrome cup.

"ZEROING" THE SYSTEM (shut-off valves must be open)

Whenever oil has been added, zero the system as follows, in order to set internal helm piston in the center of the helm:

(1) Set rudder (s) dead ahead

(2) Open by-pass valve

(3) Turn helm (s) hard over to the right or starboard and 3½ to 4 turns back so that king spoke is up.

(4) Close by-pass Valve

OPERATION AND "PLAY"

A certain amount of "play" is normal and necessary in any type of steering system. This play is more noticeable when docked, and may be termed "apparent" play. The Crowell Helm will have from 5° to 15° of "apparent play" with the average about 10°. Any more than 15° is due to air in the system. This should be removed as explained above in "After System Seems Filled".

LEAKS (Ref. to notes 2, 3, 4, 5, 6, 7, 12)

No hydraulic system will give complete satisfaction so long as there are any leaks. This is strictly a plumbing job, and any sources of leakage must be stopped immediately. Frequent refilling of the system can only be caused by leakage of the oil. Be sure to use a good, clean flaring tool. When all leaks are located and eliminated, refill and re-zero as mentioned above. Remember that wherever oil has leaked out, air must have leaked in and may be trapped if tubing has vertical dips and bends. To positively get rid of trapped air, flush system as shown in Figure #4.

IN GENERAL:

The Crowell Hydraulic Helm is not a power steering device. It is a hydraulic transmitter and receiver. Hydraulics provide the best method for transmitting the helmsman's efforts to the rudder arm with maximum mechanical advantage and minimum lost motion or back-lash.

If a boat is hard steering when tied to the dock, look for rudder shafts that bind or have excessive friction in the stuffing box. Disconnect the clevis of the slave cylinder and see to it that the rudder swings freely.

If the helm steers freely at the dock and requires considerable pressure under way, particularly at high speed, it is generally an indication that the rudder is not sufficiently balanced or that the rudder shaft is bent aft at the point of entry through the hull. (see remarks under note #10).

Generally, the balance of a spade type rudder can be sufficiently shifted by slightly bending the rudder shaft forward for more balance and aft for less. This procedure should only be undertaken by someone who is thoroughly competent and has theoretical knowledge as well as practical experience.

Most single screw boats and some twin screw boats have a tendency to veer to starboard or to port necessitating holding a constant pressure on the helm in order to hold a straight course. (The Crowell Hydraulic Helm automatically relieves the helmsman of this tiring job). This pull is usually caused by propeller torque and/or hull characteristics and can easily be overcome by slightly bending the trailing edge of the rudder.

If the boat pulls to port, bend the trailing edge of the rudder about 1/16" (more or less) to port and put the bend about 1" forward of the trailing edge. This acts as a "trim tab" or a "rudder on the rudder", thus overcoming the tendency of the boat to veer off course. If the boat falls off to starboard, bend the rudder to starboard.

ADDENDUM

If the foregoing has been faithfully followed, you now have America's finest, most modern, yacht steering system. Other highest quality items of Crowell Designs manufacture, built for those who want the best, are:

Automatic Water Pressure Systems - compact enough for the smallest cruisers but with adequate capacity for the largest.

D. C. Motors - to ⅓ H. P.

D. C. Pumps - all positive displacement, self priming, high volume and lift for bilge, pressure washdown, sump, fuel transfer, etc.

Flow-View Strainer - ¾" & 1" fresh water or raw engine water, or salt water systems.

Rudder Angle Indicator

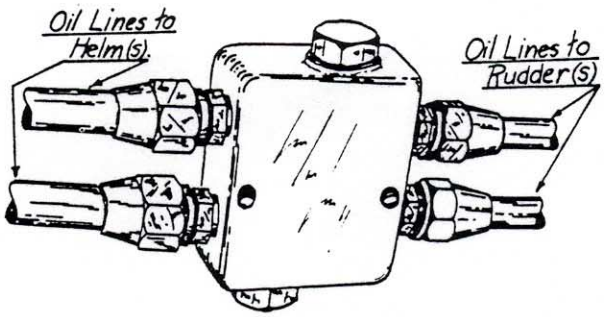
Gear Head Motors - 20:1 reduction ⅛ to ¼ H. P. reversible for large centerboards, boat davits, etc. All D. C. from 6 volts to 110 volts.

Control Transfer. For connecting 2 control stations in tandem. Gives friction-free throttle or clutch control from either of two separate control stations.

CROWELL DESIGNS, Inc.

2106 Bridge Ave. Point Pleasant, N. J.

Please Leave These Instructions Aboard for the Owner!!!

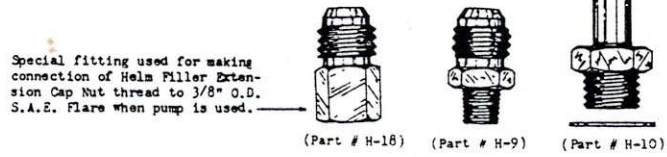


Two Way Safety Valve.

APPLICATION: All types of steering gears no matter whether they are rods, gears, cable, or hydraulic are subject to damage if through accident they are subjected to shocks in excess of their designed strength. Unlike other types, it is possible to protect our Hydraulic Helm against overloads. This can be provided for by installing this two-way pressure relief safety valve which will allow the oil to by-pass from one side of the system to the other if rudder arm strains exceed approximately 900 pounds. Thus the inclusion of this simple device could easily prevent damage to helm parts running into many times its modest cost.

Needless to say, the Helm should be re-zeroed immediately after any extraordinary shock has caused this safety valve to by-pass.

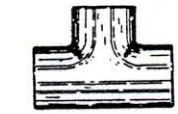
Installation is simple: the valve need only be connected across the two oil lines, as shown. To order, specify - "TWO WAY SAFETY VALVE" (Price, $22.50, list.)



Special fitting used for making connection of Helm Filler Extension Cap Nut thread to 3/8" O.D. S.A.E. Flare when pump is used.

(Part # H-18) (Part # H-9) (Part # H-10)

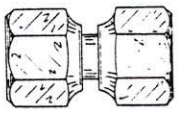
These fittings are for assisting bleeding operation when using pump. Part # H-9 has 1/8" pipe thread to fit slave cyl. bleed plug holes and 3/8" S.A.E. flare thread for connecting to pump. Use short piece of 3/8" tubing with nut part # H-5. Part # H-10 has special male thread to fit Helm filler holes and 1/8" female pipe thread to take short 1/8" pipe as shown. Neoprene tubing may be attached to latter with or without elbow or street el.



½" O.D. Solder Type Tee. (Part # H-14)

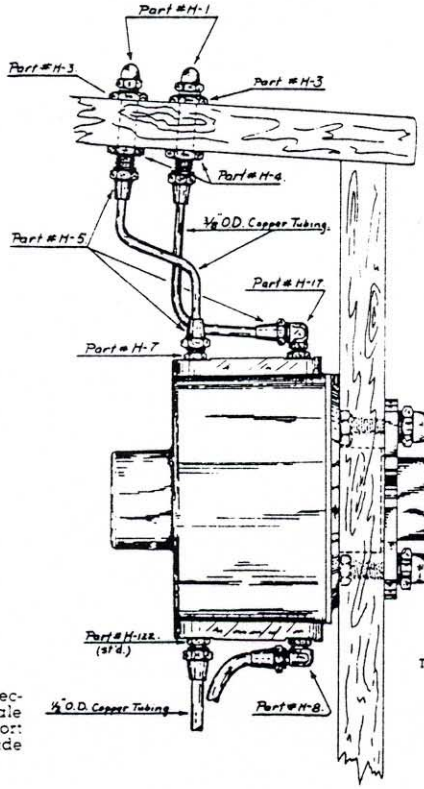
½" O.D. Solder Type El. (Part # H-15)

½" O.D. Solder Type Union. (Part # H-16)

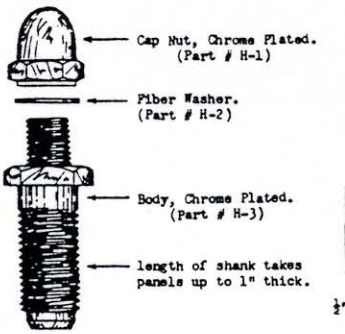


(Part # H-19)

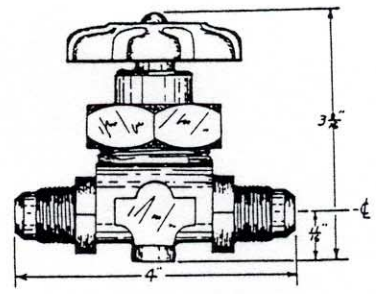
For facilitating close couple connections. This part consists of 2 female flare nuts, connected with short length of flare copper tubing. Made up over-all length, 2".



TYPICAL HELM INSTALLATION SHOWING FILLER EXTENSION CONNECTIONS.

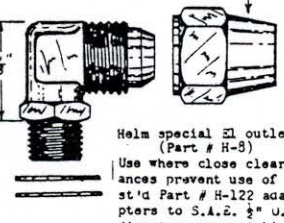


HELM FILLER EXTENSION ASSEMBLY. S.A.E. Flare Type.

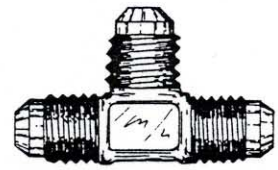


Diaphragm Packless Line Valve. ½" O.D. Copper Tubing S.A.E. Flare Type.

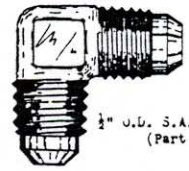
½" O.D. Copper Tubing S.A.E. Flare Nut. (Part # H-123)



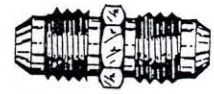
Helm special El outlet. (Part # H-8)
Use where close clearances prevent use of st'd Part # H-122 adapters to S.A.E. ½" O.D. diameter copper tubing. Use 1 or 2 fiber washers as required to obtain proper direction.



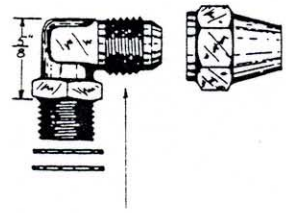
½" O.D. S.A.E. Flare Tee. (Part # H-11)



½" O.D. S.A.E. Flare el. (Part # H-12)



½" O.D. S.A.E. Flare Union. (Part # H-13)



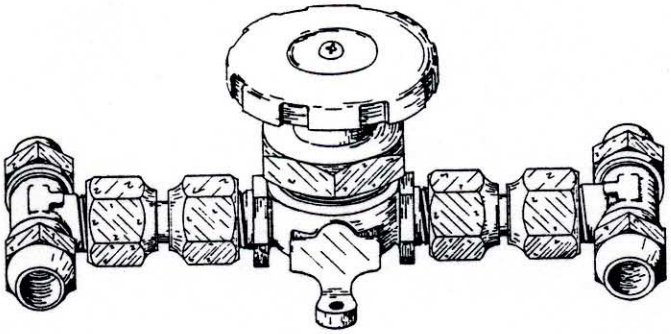
Optional El adapter. Use in place of Part # H-7 where clearances are close. Use 1 or 2 fiber washers as required to obtain proper direction. (Part # H-17).

For 2 complete 3/8" O.D., S.A.E. Flare Type straight through assemblies consisting of: Parts Nos. H-1, H-2, H-3, H-4, H-5 (2 pr.), H-7, & H-121A ORDER H-1002

For 2 complete 3/8" O.D., S.A.E. Flare Type 90° Elbow assemblies consisting of: Parts Nos. H-1, H-2, H-3, H-4, H-5 (2pr.), H-17 & H-121A ORDER H-1003.

NOTE: S.A.E. Flare Type assemblies are recommended where no working or weaving between the parts that support the Helm and the filler extensions is expected and accessibility permits their use.

VARIOUS STANDARD AND SPECIAL FITTINGS AVAILABLE FOR USE WITH HYDRAULIC HELM INSTALLATIONS. Order by Part Number.

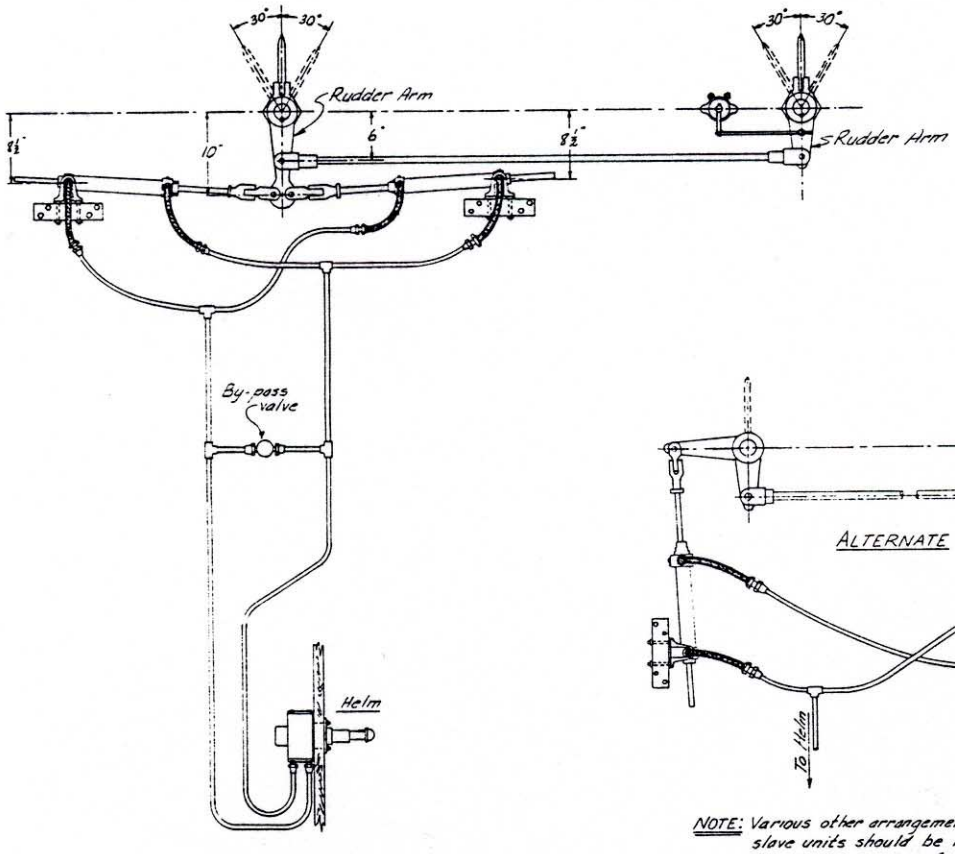


BY-PASS VALVE ASSEMBLY

Price $15.00 F.O.B.

This by-pass valve assembly is available on order.

Consists of one diaphram valve with forged body.
Two close-coupled female ½" SAE flare swivels.
Two forged ½" flare tees.
Four ½" SAE flare nuts.



DUAL SLAVE INSTALLATION FOR LARGE BOATS

NOTE: Various other arrangements are practicable but in all cases slave units should be hydraulically in parallel, not series. See pages 2 and 3 of instruction manual for other layouts.