BENSEN

8·91 H

FUEL SYSTEM

USE APPROVED FUEL ONLY
Tank CAPACITY - 6 U. S. Gal.

For McCulloch 4318AX, E, and G Engines Modified & Equipped per BENSEN Plans and Manuals:

110/130 or 115/145 Octane Gasoline, Mixed 10 parts fuel to 1 part SAE 1065 grade Mineral Base oil -

or

100 or 100LL grades AVGAS mixed 21 parts fuel to 1 part McCulloch 40[illegible] 2-cycle engine lubricant.

BENSEN AIRCRAFT CORPORATION
P.O. Box 31047 Raleigh, N. C. 27622 U.S.A.

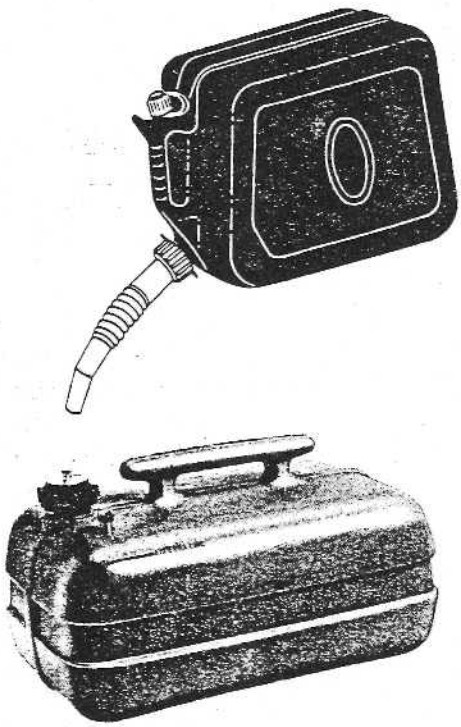


TABLE OF CONTENTS

8-91H FUEL SYSTEM

SUPPLIED PARTS & MATERIAL LIST

MODEL B-80 — Drawings & Instructions Attached

Part No.	Qty.	Description and Use
8-91H-001	1	1/8 x 1-1/2 x 1-1/2 x 15-1/4 Alum. Sheared Angle -- Front Support
-002	1	1/8 x 1-1/2 x 1-1/2 x 15-1/4 Alum. Sheared Angle -- Rear Support
-003	1	1/8 x 1 x 1 x 18-3/4 Alum. Angle -- Left Frame
-004	1	1/8 x 1 x 1 x 18-3/4 Alum. Angle -- Right Frame
-005	1	1/8 x 1 x 1 x 10 Alum. Angle -- Frame End
-006	1	1/8 x 1 x 1 x 10 Alum. Angle -- Frame End
-007	4	Finished Cable Assemblies with Thimbles -- Tank Retention
-008	1	6-gal. Fuel Tank
-009	1	20" Strip, Vinyl Chaffing Molding -- Tank Protection
-010	1	.063 x 4-1/2 Formed Pressure Gauge Mount Bracket with Drilled Hole
-011	1	0 to 15 psi Fuel Pressure Gauge
-012	1	Primer Bulb Assembly with Line Clips -- Fuel Primer
-013	1	Diaphram Fuel Pump Assembly
-018	1	3/4 x 1-3/8 x 1/8 Alum. Plate -- Clamp Plate
C404	1	10' length 1/4" I.D. Fuel Line
C405	1	18" length 5/16" I.D. Fuel Line

8-91H Fuel System Hardware & Fittings

91H-1			
3-5A	12	10-32 x 1/4 Grip Bolt	Frame & Cable Retention
4-25A	2	1/4-28 x 2-3/16 Grip Bolt	-001 Support to Keel
4-26A	2	1/4-28 x 2-5/16 Grip Bolt	-002 Support to Keel
5220	2	3/4 x 1-1/4 Hose Clamps	-010 to Tank Handle
12-2S	2	3/4 x 2 Springs	-007 and Tank Retention
PPC-8	4	1/2 Plastic Clamps	Fuel Line Support
PPC-12	2	3/4 Plastic Clamps	Fuel Line Support
520-10-8	6	10-32 x 1/2 Machine Screws	PPC to Frame
1183	4	3/16 x 3/4 Flat Washer	-007 Retention
1000-50	2	1/2 I.D. Belleville Washers	-011 to -010
[illegible]716	3	7/16 x 7/8 Flat Washers	-011 Spacers
[illegible]	6	5/16 x 5/8 Hose Clamps	Pump & Filter Clamps
[illegible]	1	1/4-28 x 3-3/16 Grip Bolt	-013 to Frame
4-37A	1	1/4-28 x 3-7/16 Grip Bolt	-013 to Frame
91H-014	1	3/4 Dia. x 3/4 Alum. Rod	Pump Hole Plug
91H-015	1	Disposable Fuel Filter	
91H-016	1	1/4 I.D. x .575 Alum. Tube	-013 Spacer
91H-017	1	1/4 I.D. x .700 Alum. Tube	-013 Spacer
4750	2	1/4 x 3/4 Flat Washer	-013 Retention
52-022-094	1	3/32 x 1-1/4 Roll Pin	-014 Retention
960-10	18	3/16 x 7/16 Flat Washers	
364-1032	18	10-32 Lock Nuts	
960-416	6	1/4 x 1/2 Flat Washers	
364-428	6	1/4-28 Lock Nuts	

Part No.	Qty.	Description and Use
8-91H Fuel Fittings (See Drawing No. 91H-3 for location.)		
M670-CL	1	1/4 x 1/4 Fuel Shut-Off Valve
2202P-4-4	1	1/4 x 1/4 90 degree Street Elbow
2203P-2	1	1/8 Tee
B-124	1	1/8 45 degree Elbow
04-04MB	1	1/4 x 1/4 Coupling
05-02MB	1	5/16 x 1/8 Coupling
04-02MB90	2	1/4 x 1/8 Coupling Elbow
04-02MB	1	1/4 x 1/8 Coupling

The 8-91H Fuel System construction can be completed with common hand tools and a 1/4 Drill Motor. A STAND MOUNTED DRILL MOTOR IS BETTER, if available, to obtain perpendicular holes. As suggested in the opening page, refer to the "B-80 Construction and Tooling Manual" for proper drilling procedures.

ALL HOLES to be drilled in your Fuel System frame will be 1/4" or less in diameter, and not over 1/4" deep. All holes to be drilled will have their diameters listed on the drawing, or will be noted as follows:

1/4" diameter --- "A" 3/16" diameter --- "B"

HARDWARE SELECTION AND PLACEMENT

All hardware is identified on the Packing list by a PART NUMBER, with sizes. All hardware placement is identified on the drawings by this PART NUMBER. A flat washer is installed under ALL attaching nuts, unless instructed otherwise in the steps. All Castellated Nuts are safetied with a Cotter Pin.

RECOMMENDED TORQUE VALUES

	Bolts in Shear	Bolts in Tension
3/16 Dia. Bolts ----------	12-15 inch lbs.	25 inch lbs.
1/4 Dia. Bolts ----------	30-40 inch lbs.	60 inch lbs.

USE THESE VALUES CONSISTENTLY UNLESS INSTRUCTED OTHERWISE IN THE PROCEDURE!

GENERAL OPERATION AND FUNCTION OF THE FUEL SYSTEM

The fuel pick-up line is factory-installed and positioned on the bottom, right-rear of the fuel tank, with a strainer screen in the end of line. This is connected to the fuel tank outlet fitting. A fuel shut-off valve is then connected to this outlet fitting, and through a C404 Fuel Line, routed to the Fuel Pump Inlet.

The diaphram Fuel Pump is actuated twice each revolution of the engine by crankcase positive and negative pressure pulses, thereby pumping fuel from tank outlet to Fuel Pump Inlet and through Pump Outlet to Carburetor through a disposable filter.

The Fuel Pump has a second fuel outlet which is connected to the fuel pressure gauge, then to a squeeze-primer bulb, which has a built-in reverse flow check valve. The bulb is then connected to a fuel line which passes through a drilled hole in the fuel tank handle, and on to the bottom of the tank. With this arrangement, the Carburetor bowl can be filled by squeezing the bulb for engine starting. The bulb also can be used as an emergency fuel pump to maintain a constant fuel pressure if for any reason in-flight your fuel pressure should drop below the required minimum of 2-1/4 psi. This will allow you to fly to a safe landing spot by acting as your own fuel pump.

The fuel tank is very rugged to impact and is light in weight. It incorporates a fuel quantity gauge in the filler cap. The main fuel pick-up, or outlet line has been modified for you.

A fuel pressure gauge is mounted on the fuel tank to monitor proper function of the system.

READ CAREFULLY THE FOLLOWING TEXT BEFORE STARTING ANY MODIFICATION OR FABRICATION OF PARTS. LOCATE AND IDENTIFY ALL PACKAGE PARTS. AFTER ASSEMBLY COMPLETION, BE SURE TO ERASE ALL PENCIL LAY-OUT LINES AND RE-CHECK ALL STEPS TO MAKE SURE YOUR FUEL SYSTEM IS INSTALLED CORRECTLY.

CONSTRUCTION STEPS

The following procedural steps have been developed for the easiest construction sequence for the 8-91H Fuel System. We suggest that you complete one step at a time, and follow the numerical sequence of steps. Be sure and read this entire Manual completely before beginning construction.

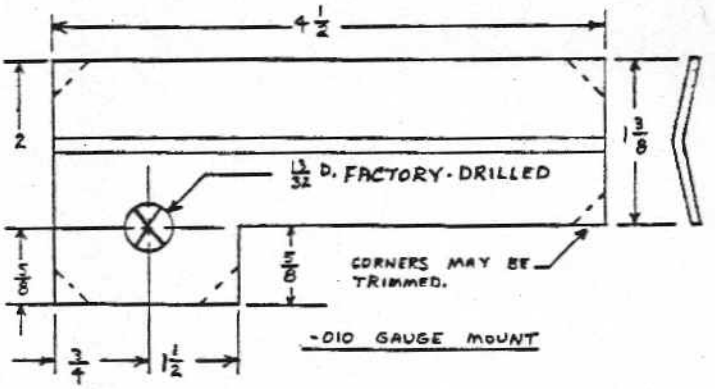
FRAME CONSTRUCTION --- Drawing No. 91H-1 & 91H-2

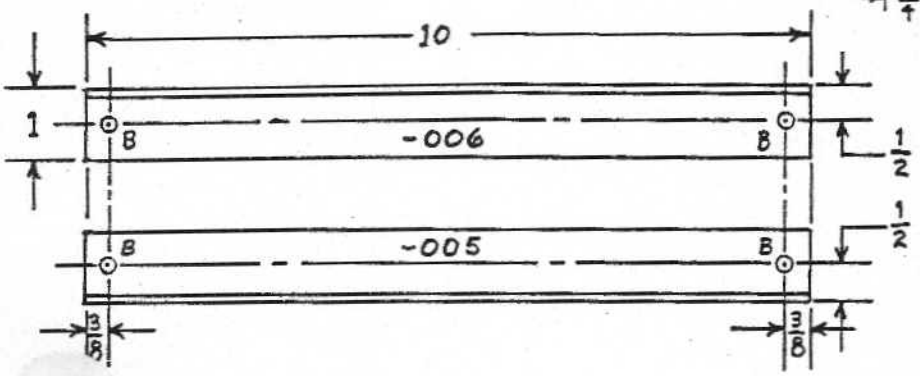
1. Lay out and drill -001, -002, -003, -004, -005, and -006 Frame Angles.
2. Assemble rectangular frame, -003, -004, -005, and -006 with 3-5A bolts. The -005 and -006 Angles are inside and on top of -003 and -004 angle, flush with the outside edges of -003 and -004. File radius on bottom web of -005 and -006 angles.
3. Cut (4) -009 Chaffing Pads 3" long, and (4) pieces 2" long. Center 3" pads on each Cable Assembly attaching hole with the beveled side outside.
4. Attach -007 Cable Assemblies to the outside web of -003 and -004 angles with 3-5A bolts, with their heads inside of frame. Place an 1183 washer outside of cable thimble.
5. Attach frame assembly to -001 and -002 support angles with 3-5A bolt heads inside of frame.
6. Remove -017 angle from Keel and Axle tubes.
7. Align and square frame supports to Keel using bolt through support and Keel tube as a pivot. Transfer (2) attaching holes through Keel. Remove and drill.
8. Locate -017 angle with web down as shown. Clip off ends of -017 angle if needed to clear vertical web of -002 frame support angle. Attach supports to Keel with 4-25A and 4-26A bolts.

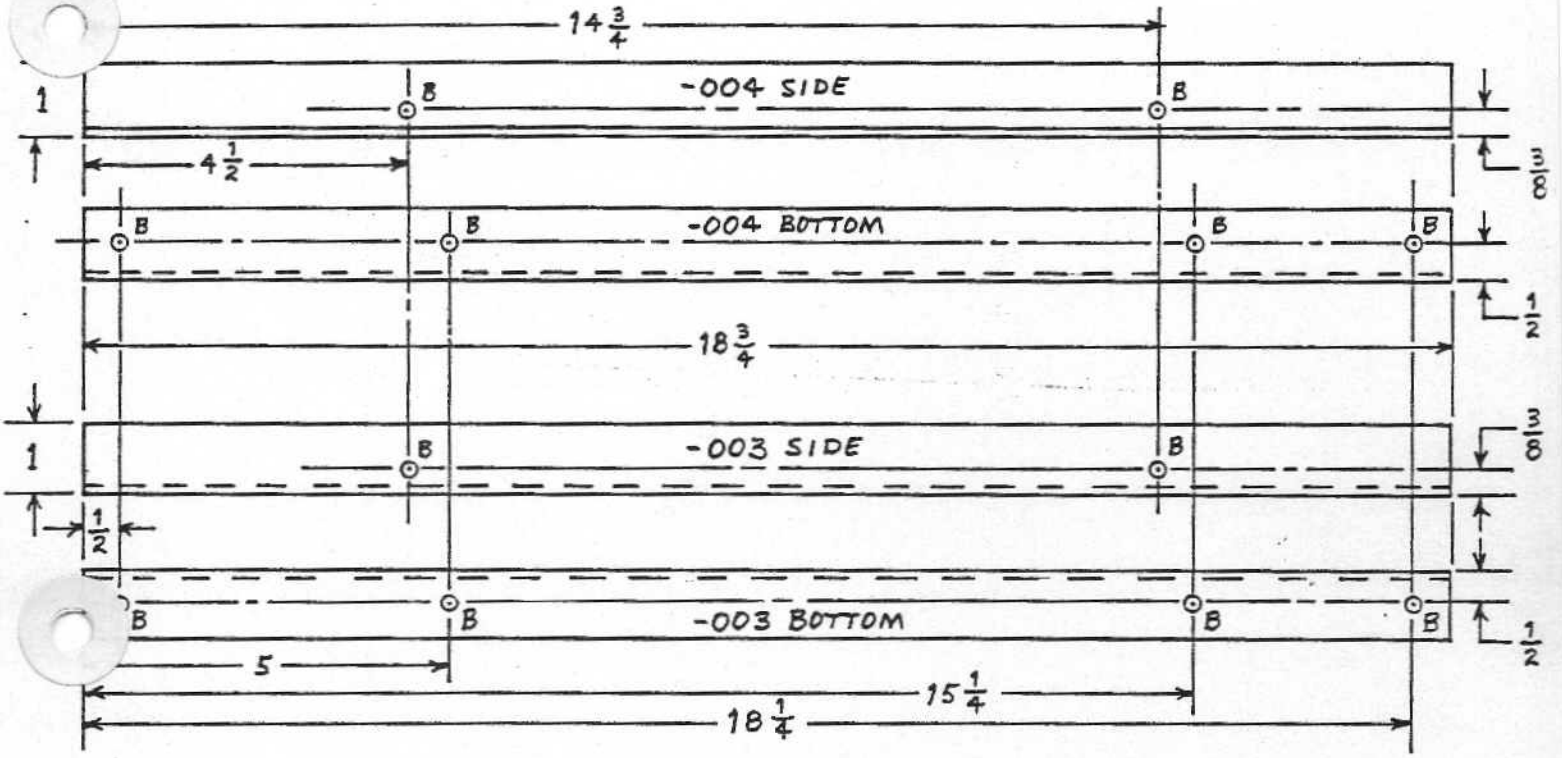
FUEL TANK AND LINE INSTALLATION ... Drawing No. 91H-3, 4, 5, & 6

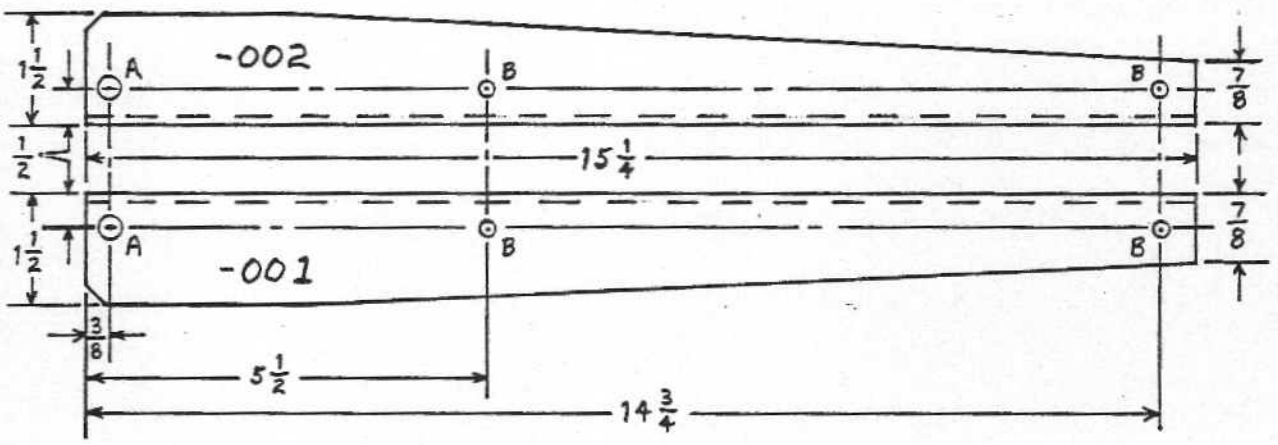
9. (Drawing No. 91H-3) Cut a 1-1/2" length of C405 Fuel Line and install on the outlet end of the Primer bulb. (END THAT THE ARROW POINTS TO.) Cut a 15-1/2" length of C405 Line and install on the inlet end of Primer Bulb. Position line clips on each end of bulb, and squeeze closed with pliers.
10. Insert the 15-1/2" length of Primer Bulb line into the predrilled hole in fuel tank handle support. Force line to touch the bottom of tank and route to the right rear corner of tank.

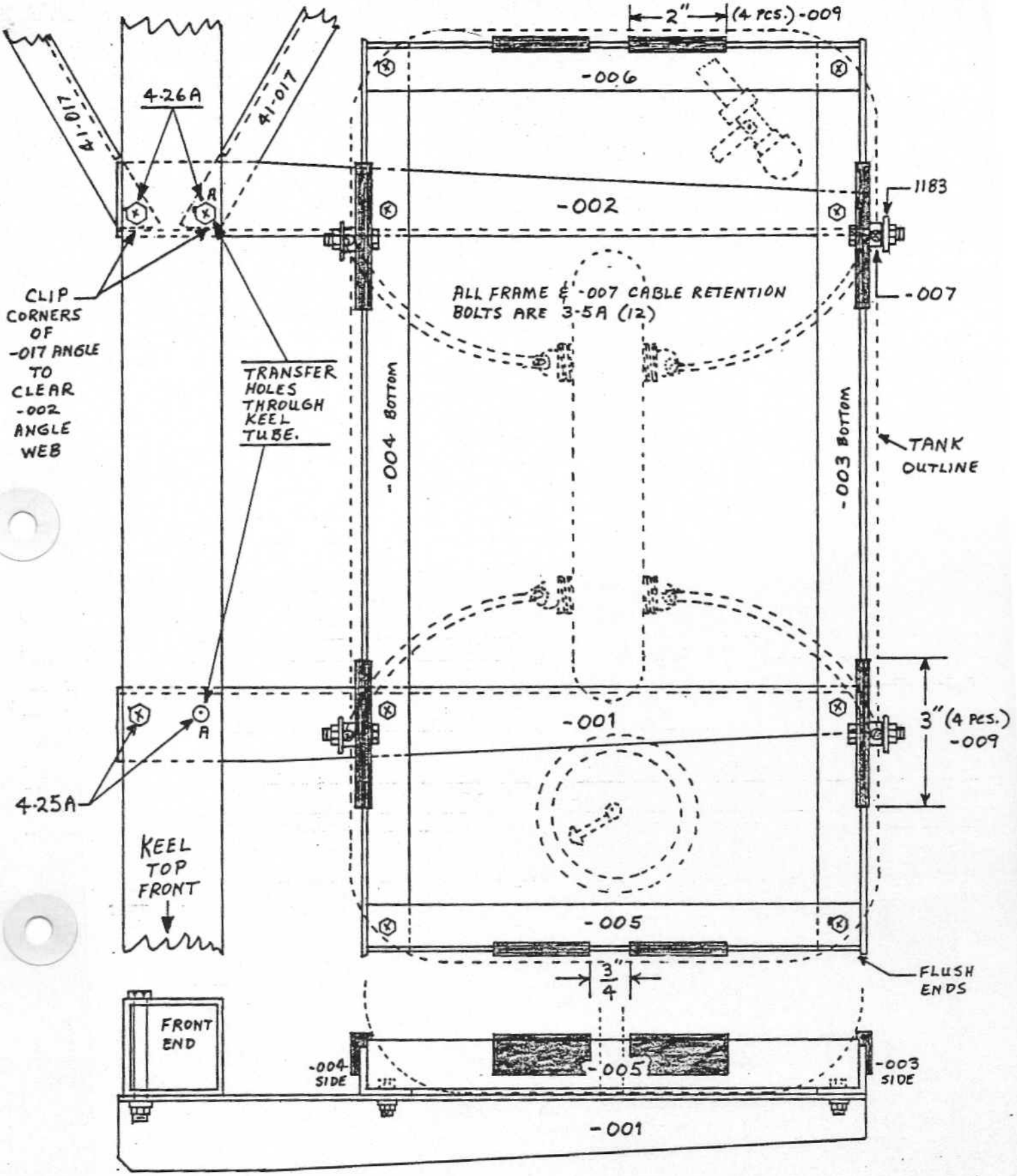
91H-1


4 1/2
2
1 3/8
13/32 D. FACTORY-DRILLED
5/8
5/8
CORNERS MAY BE TRIMMED.
-010 GAUGE MOUNT
3/4
1 1/2


10
1
B
-006
B
1/2
B
-005
B
1/2
3/8
3/8


14 3/4
1
B
-004 SIDE
B
4 1/2
3/8
B
-004 BOTTOM
B
B
B
1/2
18 3/4
1
B
-003 SIDE
B
3/8
1/2
B
-003 BOTTOM
B
B
B
1/2
5
15 1/4
18 1/4


1 1/2
A
-002
B
B
7/8
1/2
15 1/4
1 1/2
A
B
B
7/8
-001
3/8
5 1/2
14 3/4


2" (4 PCS.) -009
-006
4-26A
41-017
41-017
A
-002
1183
-007
ALL FRAME & -007 CABLE RETENTION BOLTS ARE 3-5A (12)
CLIP CORNERS OF -017 ANGLE TO CLEAR -002 ANGLE WEB
TRANSFER HOLES THROUGH KEEL TUBE.
-004 BOTTOM
-003 BOTTOM
TANK OUTLINE
-001
3" (4 PCS.) -009
A
4-25A
KEEL TOP FRONT
-005
FLUSH ENDS
3/4"
FRONT END
-004 SIDE
-005
-003 SIDE
-001

91H-2

11. (Drawing No. 91H-4 & 5) Mount the -013 Fuel Pump on the right side ONLY of 8-81B Engine Mount support. Remove the (2) drawing noted 1/4" bolts from 81B-018 Engine Mount Gusset and replace with 4-35A and 4-37A bolts. Install -016 and -017 Spacers. Enlarge holes in Fuel Pump casting if necessary for proper fit. Install 4750 washers and secure.

12. (Drawing No. 91H-3) Install a B-124, 45 degree elbow in the tapped engine crankcase hole and position the outlet hole toward Mast and up slightly. Route C404 Fuel Line from brass outlet on back of -013 Fuel Pump to B-124, and connect with a 04-02MB coupling. Secure line to Fuel Pump with a 6202 Clamp.

13. Install a 2202P-4-4 Street Elbow in the Fuel Tank brass fuel outlet nut, and position as shown. Be sure pretorqued brass nut in Fuel Tank is held with a wrench when installing elbow. Remove the handle from M670-CL Fuel Valve. Hold installed elbow and connect valve. Re-install the handle on valve. (Note: Fuel is "ON" when valve handle is parallel to fuel line and fitting.)

14. Install -011 Fuel Pressure Gauge on 2203P-2 Tee and -010 Gauge Mount Plate as shown. Belleville Spring washers should be installed on each side of Mount Plate, cup-to-cup. Shim with 960-716 Washers as necessary for a snug fit. Install gauge mount on tank handle using 5220 Clamps as shown in Drawing 91H-5.

15. Connect the 1-1/2" line of Primer Bulb to 2203P-2 Tee, using 05-02MB coupling. Install 04-02MB90 Elbow to Tee bottom, and route C404 Fuel Line from Tank approximately parallel with Handle. Do not cut line yet.

16. Position Fuel Tank in pre-installed frame with the filler neck forward, and retain in position with the 12-2S Springs under handle support post. Springs are connected to -007 Cable assemblies as shown in Drawing 91H-5 and 6. Be sure all Chaffing Pads are in position.

17. Route C404 Line connected to Pressure Gauge elbow to front of Mast tube as shown, and to front Fuel Pump Outlet. Retain line on 81B-018 Gusset Plate with PPC-8 Plastic Clamp. Retain on Fuel Pump Outlet with 6202 Clamp.

18. Install 04-04MB Coupling to fuel valve. Install C404 Fuel Line and tighten Coupling supporting valve with wrench. Route fuel line to Fuel Pump inlet as shown and secure to Pump with 6202 Clamp.

Fuel Line should be routed in pairs down the side of Fuel Tank. Drill a web-centered 3/16" hole in 41-007 Steel Angle and support both lines using a PPC-12 Clamp, retained with a 520-10-8 Machine Screw. Locate hole 1/2" from Mast.

Line should be supported on 81B-018 Gusset Plate with PPC-8 Clamp. Drill hole 3/8" from Gusset Edge in proper location to retain fuel line and retain with 520-10-8 Machine Screw. Approximate position is drawing noted. Make sure Joystick Control Linkage has adaquate clearance around fuel line.

19. Drill a web-centered 3/16" hole, 4-1/2" from the top of the right 81B-011 Brace Angle. Install C404 Fuel Line to rearward fuel outlet of Fuel Pump. Cut Fuel Line 2" long. Insert 91H-015 Fuel Filter with "Flow Arrow" pointing up and retain with 6202 Clamp. Install C404 Line to other Filter end and retain with 6202 Clamp. Route Line through PPC-8 Clamp and retain on -011 angle brace with 520-10-8 Machine Screw.

20. Lay out and drill 91H-018 Clamp Plate. Install Plate on top of 81B-001 Top Fork Plate using the rear 1/4" bolt. (Drawing No. 91H-5)

Install PPC-8 Plastic Clamp on top of the outside 3-5A bolt threads retaining 81B-006 Angle to 81B-001 Plate. Retain Clamp with extra 1032 Lock Nut provided.

Attach PPC-8 Clamp to 3/16 Hole in -018 Clamp Plate with 520-10-8 Machine Screw.

Route C404 Fuel Line Through installed PPC Clamps and connect to Carburetor using a 04-02MB90 Coupling. (See Drawing 91H-5 for details.)

The mechanical McCulloch Fuel Pump must be removed from the engine, and its cavity sealed as follows:

Remove the Fuel Pump and the lower plunger in its cavity. The plunger hole in the crankcase casting must be sealed in the following manner.

a. Seal the end and sides of the -014 Plug with a thick gasket compound, Permatex or Form-A-Gasket. Insert the -014 Plug in the Fuel Pump cavity casting in crankcase, making sure it seats well on the bottom.

b. Drill a 3/32" hole through pump base casting and plug, 3/4" down from the outside face of casting and insert provided roll pin.

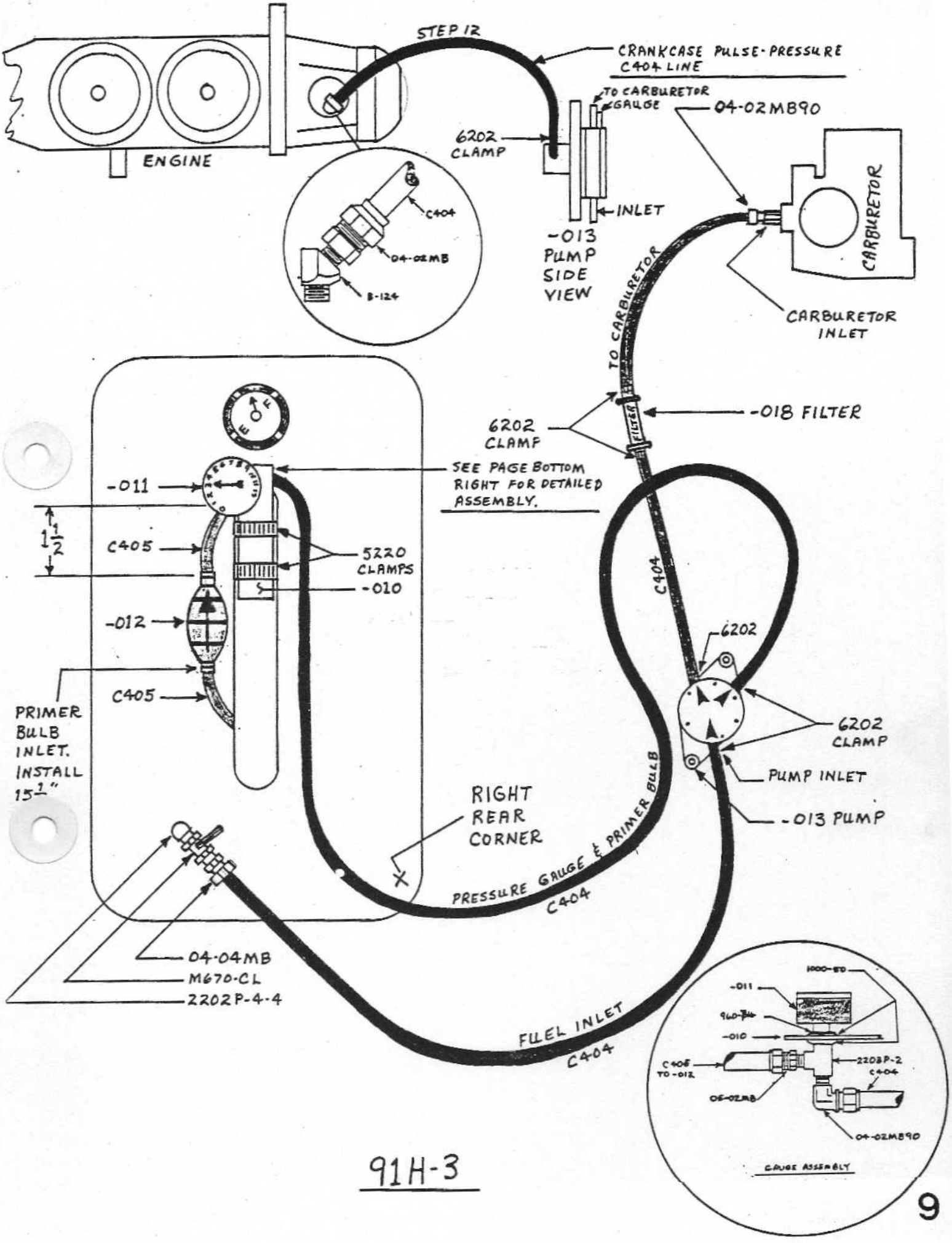
CAUTIONS

Before operating fuel system, open the vent screw located on top of the filler cap of fuel quantity gauge.

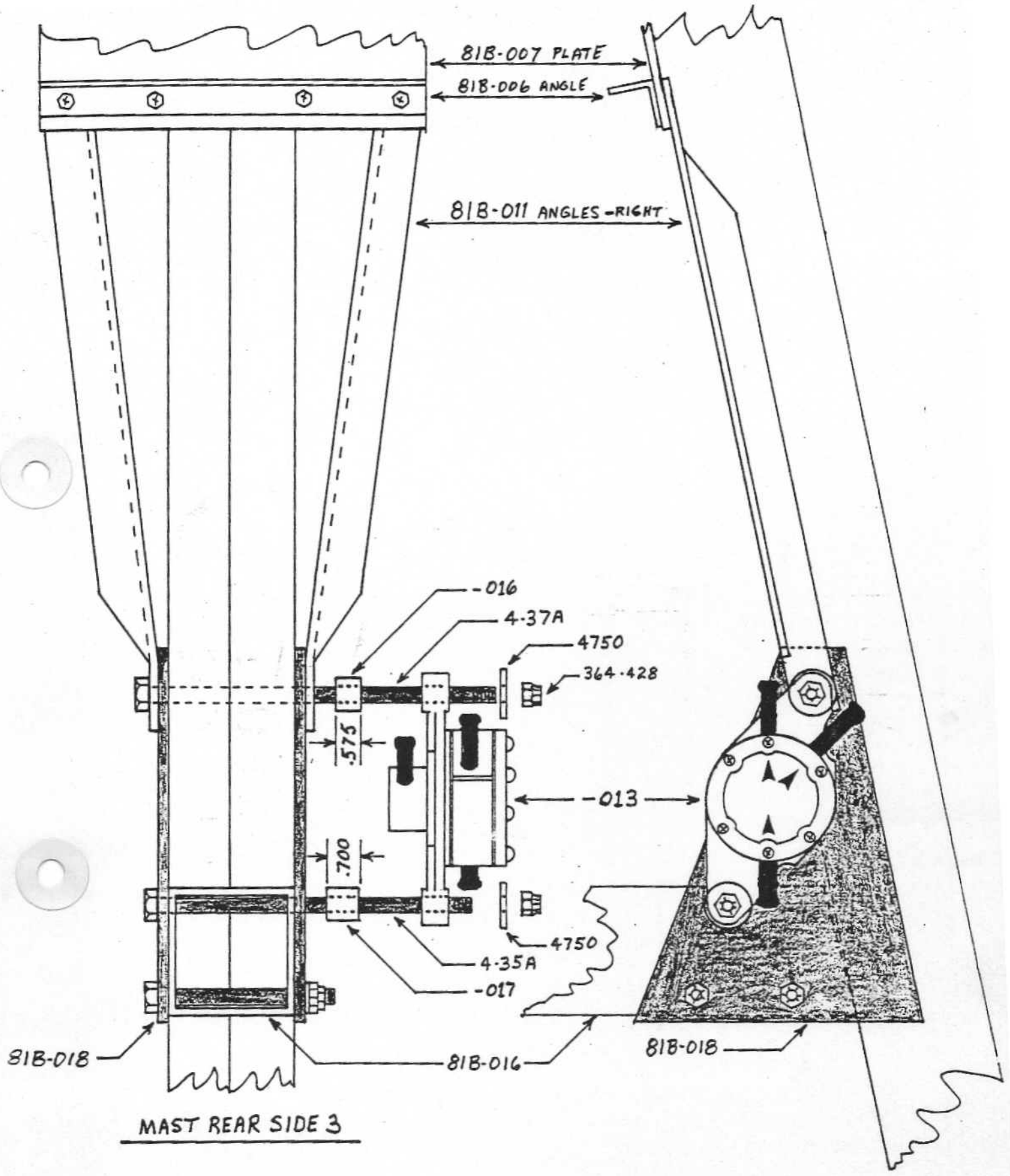
The internal fuel pick-up line MUST have the inlet screened opening positioned to the rear of fuel tank, and should lay on the tank bottom to assure full fuel availability. The brass outlet fitting is properly tightened and positioned to allow this. CHECK TO MAKE SURE IT REMAINED IN POSITION DURING SHIPPING AND INSTALLATION OF THE FUEL SYSTEM.

When installing the fuel line fittings, the brass nut MUST be prevented from rotating to prevent inlet end of fuel pick-up line from lifting off tank bottom or sliding up tank wall.

All fittings will be easier to install, and have a tighter seal if a "FUEL LUBE" type compound is used on fitting threads prior to tightening.

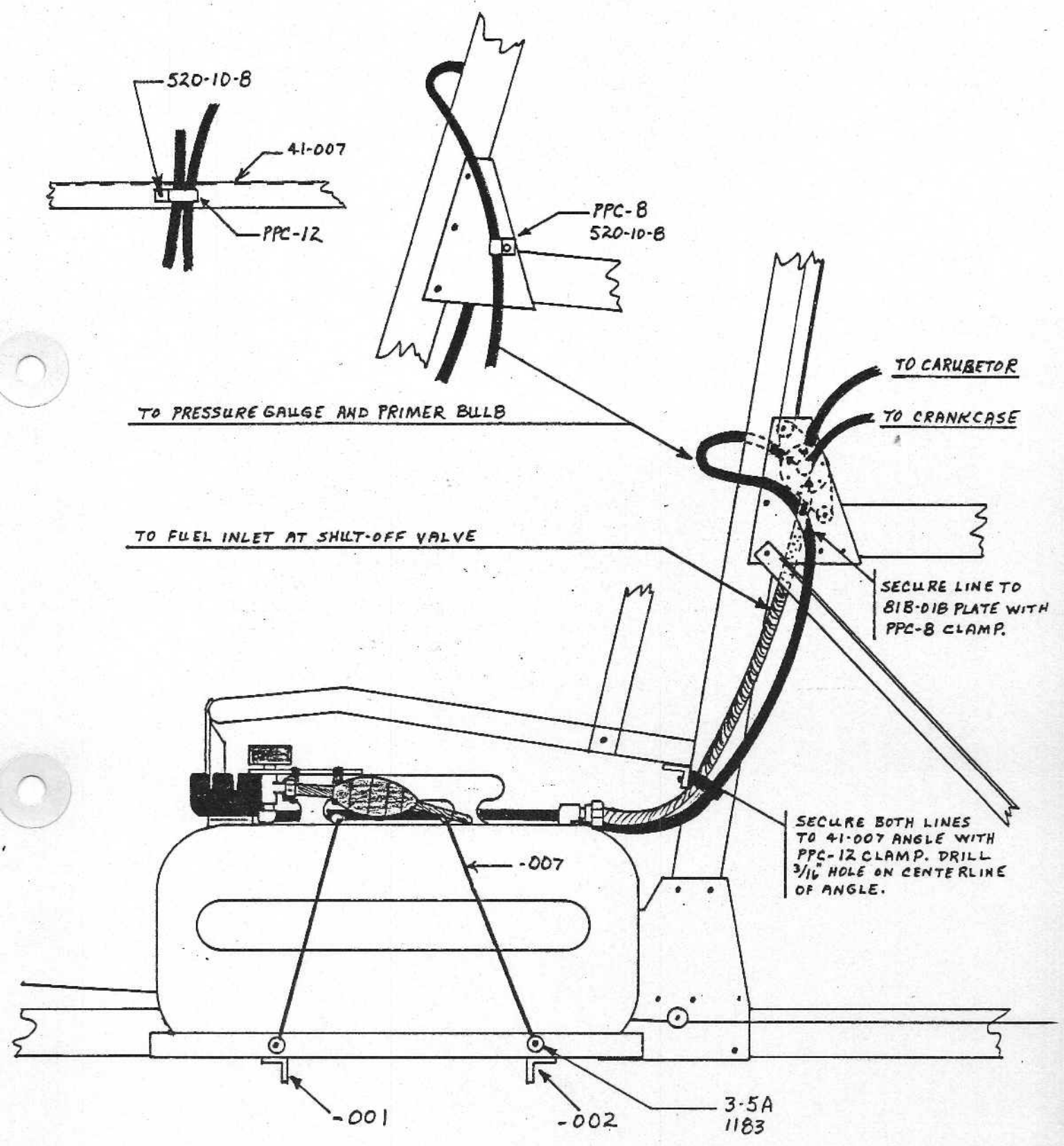

STEP 12
CRANKCASE PULSE-PRESSURE C404 LINE
TO CARBURETOR GAUGE
04-02MB90
6202 CLAMP
INLET
-013 PUMP SIDE VIEW
ENGINE
C404
04-02MB
B-124
CARBURETOR
CARBURETOR INLET
TO CARBURETOR
-018 FILTER
FILTER
6202 CLAMP
SEE PAGE BOTTOM RIGHT FOR DETAILED ASSEMBLY.
-011
1 1/2
C405
5220 CLAMPS
-010
-012
C405
PRIMER BULB INLET. INSTALL 15 1/2"
C404
6202
6202 CLAMP
PUMP INLET
-013 PUMP
RIGHT REAR CORNER
PRESSURE GAUGE & PRIMER BULB
C404
04-04MB
M670-CL
2202P-4-4
FUEL INLET
C404
1000-80
-011
960-7W
-010
C405 TO -012
2202P-2
C404
04-02MB
04-02MB90
GAUGE ASSEMBLY

91H-3


818-007 PLATE
818-006 ANGLE
818-011 ANGLES -RIGHT
-016
4-37A
4750
364-428
.575
-013
.700
4750
4-35A
-017
818-018
818-016
818-018
MAST REAR SIDE 3
MAST RIGHT SIDE 4

91H-4

0


520-10-8
41-007
PPC-12
PPC-8
520-10-8
TO CARUBETOR
TO CRANKCASE
TO PRESSURE GAUGE AND PRIMER BULB
TO FUEL INLET AT SHUT-OFF VALVE
SECURE LINE TO 81B-D1B PLATE WITH PPC-8 CLAMP.
SECURE BOTH LINES TO 41-007 ANGLE WITH PPC-12 CLAMP. DRILL 3/16" HOLE ON CENTERLINE OF ANGLE.
-007
-001
-002
3-5A
1183

91H-6

BEFORE OPERATION

Pour a small amount of fuel into the tank. Open M670-CL valve and pump fuel through the system by the squeeze bulb to purge lines. Disconnect line at Carburetor. Hold thumb over the end of line and squeeze primer bulb. The bulb should then become hard to pump. Check all connections for leaks under pressure. Reconnect line to Carburetor.

TO CALIBRATE THE FUEL TANK QUANTITY GAUGE ... set your Gyro on main wheels and nosewheel. Note then the empty position of fuel quantity gauge and mark the gauge.

Pour 1-1/2 gallons of fuel in tank and again mark the location of the indicator needle on the gauge. Fill tank completely and again mark the "FULL" needle reading.

You will now be able to tell at a glance the exact quantity of fuel remaining in your tank at a glance.

NORMAL OPERATING FUEL PRESSURES

1500 to 2000 Engine RPM ... 2.6 to 2.8 psi
3300 Engine RPM ..... 2.8 to 3.+ psi
Maximum Engine RPM ..... 2.8 to 3.+ psi

This completes the installation of your 8-91H Fuel System. Recheck all work and make sure your unit functions properly.

Bensen Aircraft Corporation
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CORRECT FUEL MIXTURE

USE APPROVED FUEL ONLY
Tank CAPACITY - 6 U.S. Gal.

For McCulloch 4318AX, E, and G Engines Modified & Equipped per BENSEN Plans and Manuals:

110/130 or 115/145 Octane Gasoline, Mixed 10 parts fuel to 1 part SAE 1065 grade Mineral Base oil -

or

100 or 100LL grades AVGAS mixed 21 parts fuel to 1 part McCulloch 40/1 2-cycle engine lubricant.

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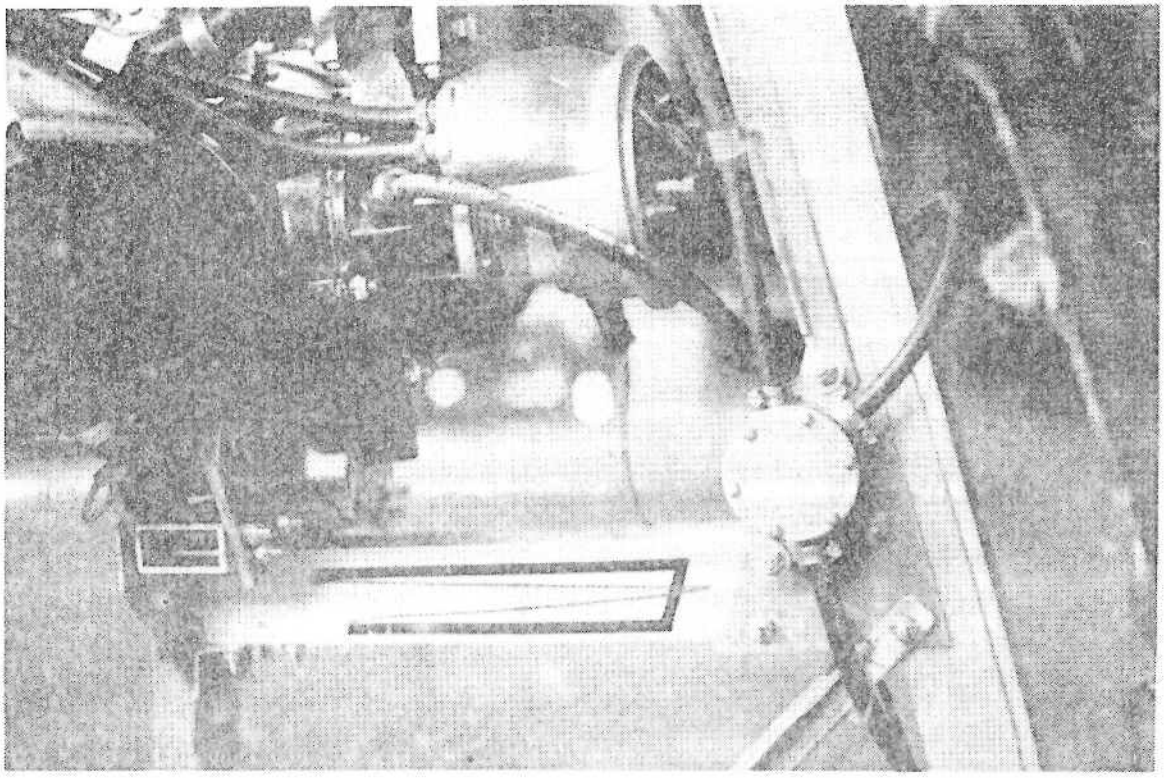
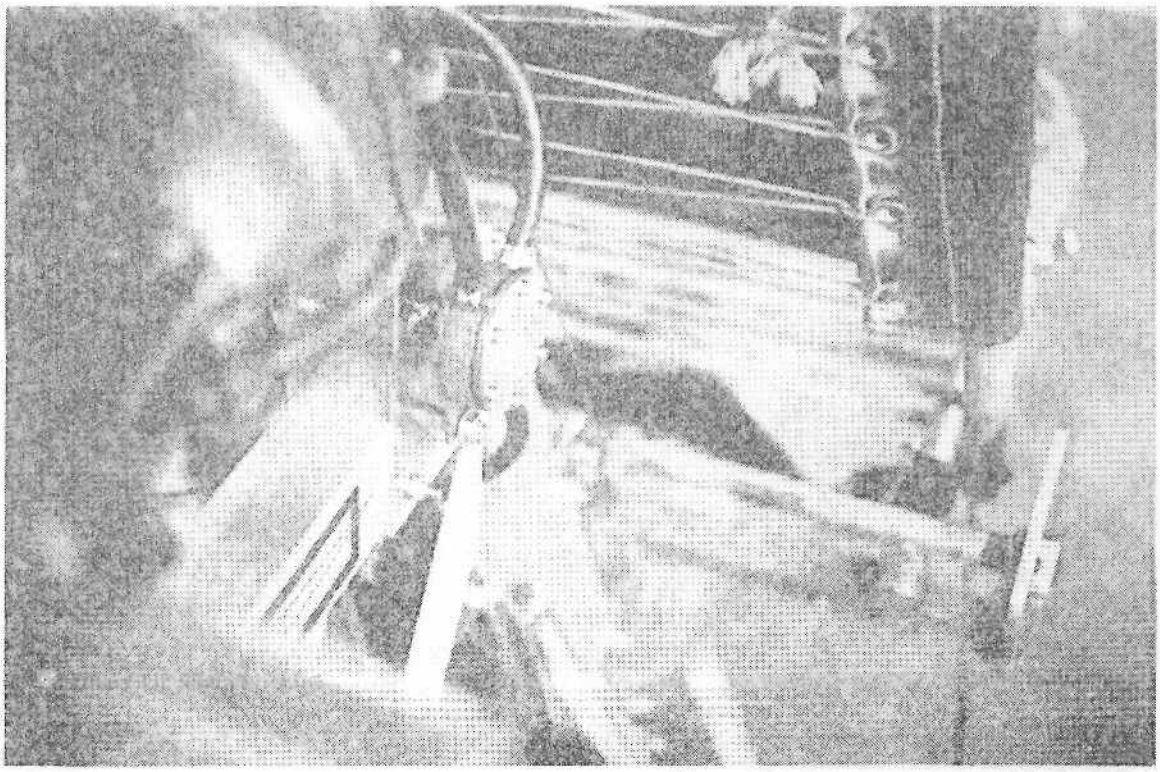


Fuel Pump shown mounted to 81B-018 Gusset Plate. The Fuel Filter is not shown. However, it is located between the Fuel Pump and the PPC-8 Plastic Clamp mounted on the 81B-011 Angle, and retained with (2) 6202 Clamps.

Note Spacers: .575" and .700" between Fuel Pump and 81B-018 Plate, with 4750 Washers on outside of Pump leg.



GOOD TIPS FROM FAA

Many, or maybe all of the FAA "GADO'S" publish very informative newsletters. Most of the literature is basically designed and tailored for "fixed-wing" pilots; however, on occasion there are helpful hints that can also apply to us Gyronauts, such as the following reprint from the Charlotte, N.C. GADO office.

FUEL CONTAMINATION: Several recent accidents have occured where fuel contamination was a factor. The presence of any contamination in fuel systems is dangerous.

A few common causes of fuel contamination are water, rust, dust and sand.

All aviation fuels absorb moisture and contain water in both suspended particles and liquid form. The amount of suspended particles varies with the temperature of the fuel. When fuel temperature is decreased, suspended particles are drawn out of the solution and slowly fall to the bottom of the tank. Whenever fuel temperature increases, water is drawn from the atmosphere to maintain a saturated solution. Changes in fuel temperature result in a continuous accumulation of water. During freezing temperature, this water may turn to ice, restricting or stopping fuel flow.

Pipelines, storage tanks, fuel trucks and drum containers tend to produce rust. A high degree of filtration is required to remove the liquid water and rust particles from the fuel. Fuel can be contaminated with dust and sand through openings in tanks and from the use of fuel-handling equipment that is not clean.

Infrequently used fuel tanks should have their sumps drained before filling. Agitation action of fuel entering the tank may suspend water or other contaminants which can remain suspended for many minutes.

REMEMBER.....

...Use gasoline and oil of the proper grade for your reciprocating engine.
...Use only the fuel recommended by the engine and aircraft manufacturer.
...DO NOT use additives that have not been approved by the FAA.
...If feasible, keep fuel tanks full. Water condenses on the walls of partially filled tanks and enters the fuel system.
...Filter all fuels entering the tank.
...Drain fuel sumps regularly.
...Periodically inject and clean all fuel strainers (screens) and occasionally flush the carburetor bowl as recommended by the manufacturer.