

ROLLS-ROYCE PHANTOM II SCRATCH BUILT COMPONENTS & MODIFICATIONS

Drawings & Guides Preface to the 9-09 Update

These Drawings and Guides began as just a handful of pages showing how you could add some super-detailed improvements to the Pocher Rolls-Royce Phantom II kits. There is much opportunity to do this since the kits leave out key components such as the complex, but very detail rich, engine controls mechanism.

As I made the changes and additions, my goal became one of building models that were as true to the prototypes as possible. In other words to move from building just another model to building something that was much closer to a replica of a specific model or a narrow period of manufacture. This focus on accuracy was, and is, driven by the simple notion that even though the vast majority of the world will neither notice nor care, those that know will know!

The more I did, and the more I looked, the more I realized how much was missing or misrepresented. So the changes, and number of pages have grown. There are now over seventy pages and the number continues to grow. So I have chosen to divide the pages into three volumes. The first covers the engine and includes many of the previously published pages. The second covers the chassis and includes many new pages. The third, which is still in development, will cover the body.

At the end of the day, I have found these notes to be my own best reference as I start another model. I hope they will just as useful to you.

John Haddock
September 2009

ROLLS-ROYCE PHANTOM II SCRATCH BUILT COMPONENTS & MODIFICATIONS

Drawings & Guides Vol. 1 - Engine

Introduction

The Pocher kits are recognized as some of the most complex and detailed automobile kits ever made. Nevertheless compromises were inevitably made for production and commercial reasons. That leaves the door open for the brave-hearted to fix production quality issues, correct errors and, more importantly, add detail. The following pages describe & dimension some of the corrections and super detail modifications that can be made to the engine of the Rolls-Royce kits.

A word of caution, however; the pages can be intimidating. They are designed for the advanced modeler and preferably someone comfortable reading an engineering drawing. Although details on components and assemblies are provided, there are no step-by-step-by-step assembly instructions. Familiarity with the Pocher Rolls-Royce kit is assumed.

The Pocher Rolls-Royce kits are historically inaccurate, mixing a variety of components from different years of production. Some of those inaccuracies are pointed out in these notes along with ways to correct them. The notes are based on Rolls-Royce drawings and photographs of prototypes.

The pages shamelessly mix both English and metric dimensions. In addition, any scratch builder is also obliged to deal with other dimensional systems for items such as wire, drills and hardware. The last page is a matrix that attempts to link all those systems across the range of dimensions most likely to be used. Hopefully it will be a useful reference tool.

Using the Pocher kit as a platform for building an historically accurate, detailed model of the Rolls-Royce Phantom II is a long, but very rewarding journey. I trust these notes will help.

ROLLS-ROYCE PHANTOM II SCRATCH BUILT COMPONENTS & MODIFICATIONS

VOL. 1 - ENGINE

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This chart shows the major visible changes made to the Phantom II during its life. Each column represents an historically correct configuration.

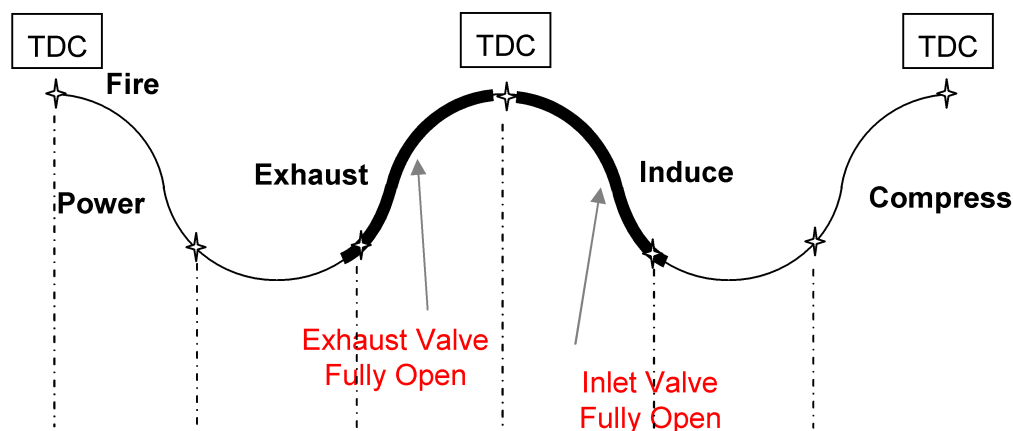
Rev 1, 9-09

www.jrhscalercars.com

FIRING ORDER & VALVE POSITIONS

The valves on the Pocher cylinder head are all in the same, closed, position. But, to be correct, at least two valves would always be open. For those valves, the springs would be compressed and the rocker arms tilted. The firing order and crankshaft position determine which valves are open. Of course, if you never intend to remove the rocker cover, none of this really matters!!

Typical Four-Stroke Cycle



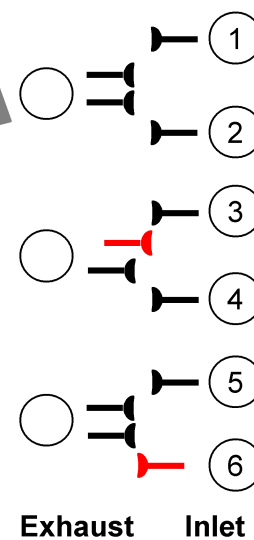
With a four-stroke cycle and the Phantom II firing order of 142635, the sequence of the positions of the pistons thru the cycle are shown in the matrix on the right. Pistons 1&6 are always in the same position, as are 2&5, and 3&4

For example, the box shows that when Cylinder 1 has fired and its piston is just past top dead center (TDC), the exhaust valve for cylinder 3 is open and the inlet valve for cylinder 6 is open. These are shown in red.

Piston Positions with a 142635 Firing Order

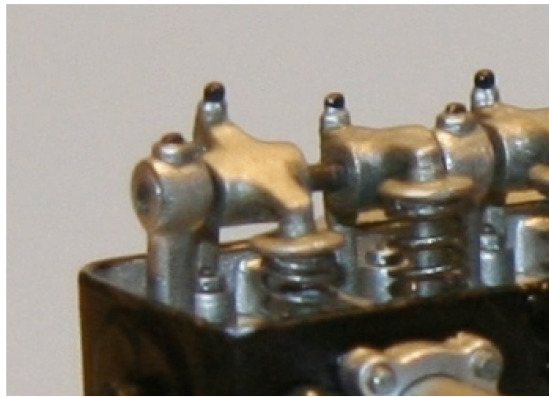
1	5	3	6	2	4
1	5	3	6	2	4
4	1	5	3	6	2
4	1	5	3	6	2
2	4	1	5	3	6
2	4	1	5	3	6
6	2	4	1	5	3
6	2	4	1	5	3
3	6	2	4	1	5
3	6	2	4	1	5
5	3	6	2	4	1
5	3	6	2	4	1
Exhaust	Inlet	Exhaust	Inlet	Exhaust	Inlet

Cylinder Head, Valve & Manifold Layout

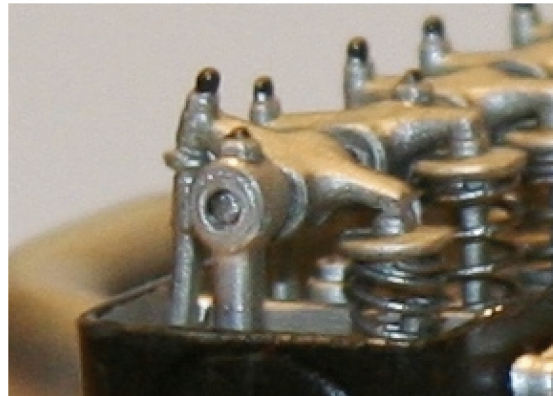
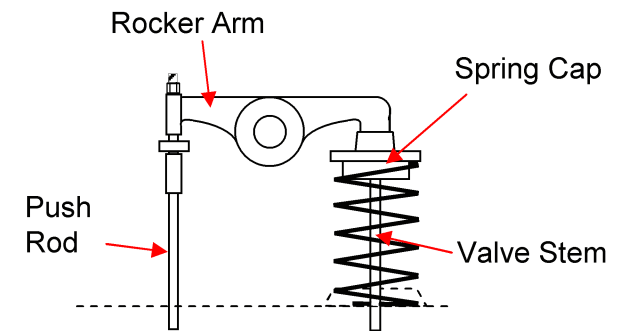


VALVE POSITIONS

These pictures and drawings show the inlet valve for cylinder #6 set in the open position. The exhaust valve for #3 cylinder would be also be open.

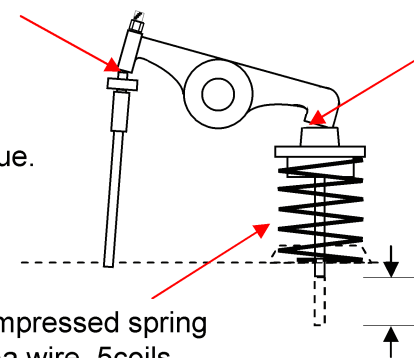


Closed (Pocher)



Open

Slice through molding about halfway, then bend carefully. Fill gap with glue.



Slice through molding about halfway, then bend carefully. Fill gap with glue.

Make compressed spring from 28Ga wire. 5coils. Paint semi-gloss black.

Shorten valve stem 2mm

CYLINDER HEAD

The Pocher cylinder head is a work of art. It justifies lots of attention even though the (removable) rocker cover may hide much of it. These pictures and drawings show some additional detail modifications that can be made to the cylinder head.

Fitting for water temperature gauge:



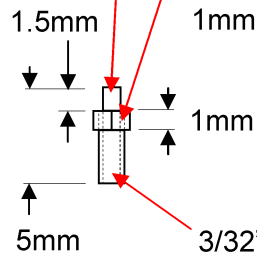
Drill $\frac{3}{32}$ " hole at approx 15° angle to accept fitting.



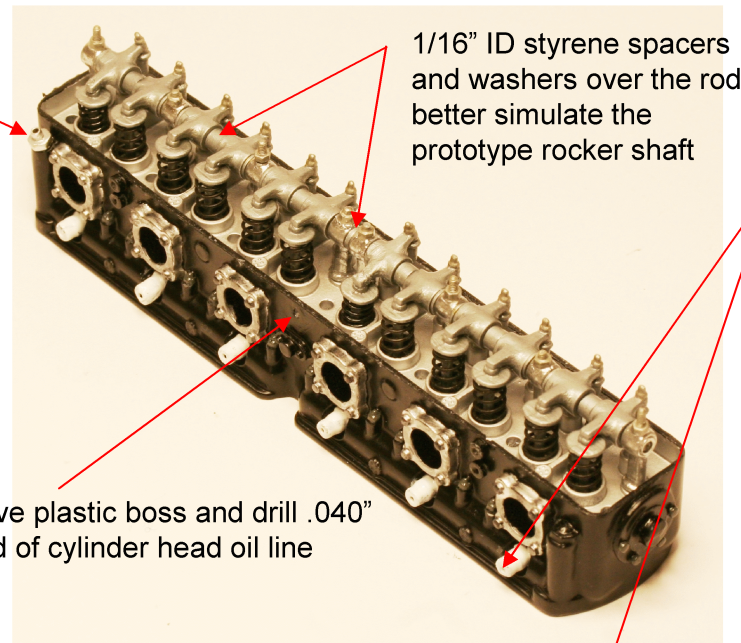
Fitting

$\frac{1}{16}$ " thin wall brass tube

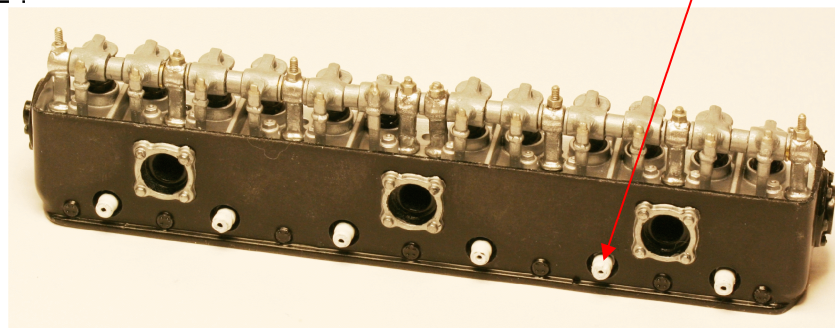
2-56 Nut.
Drill out to $\frac{3}{32}$ ".
File down to 1mm high



$\frac{3}{32}$ " brass tube



Remove plastic boss and drill $.040$ " for end of cylinder head oil line



Spark plugs:

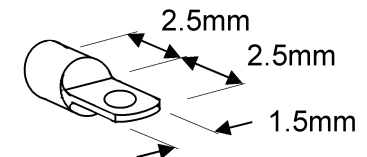
On prototypes, a spade on the end of each ignition wire was attached to a wire protruding from the end of the spark plug.



Here's one way to add those wires to the spark plugs.

Carefully drill out the end of the spark plug to $\frac{5}{64}$ ". Insert a $\frac{5}{64}$ " thin wall tube ($\frac{1}{16}$ " ID). Insert a $\frac{1}{16}$ " normal brass tube. Insert a $\frac{1}{32}$ " rod to accept the spades.

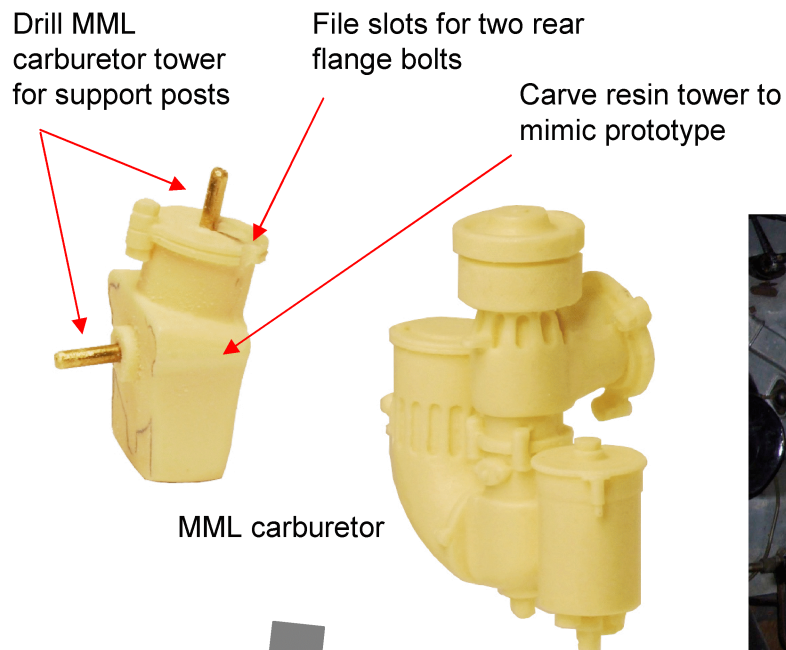
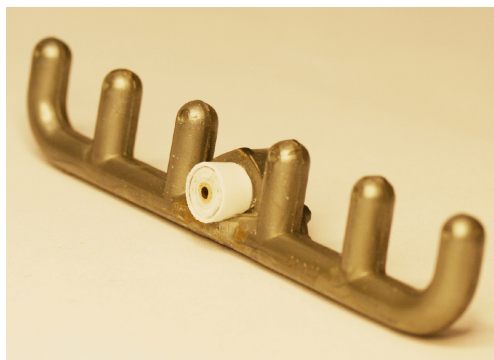
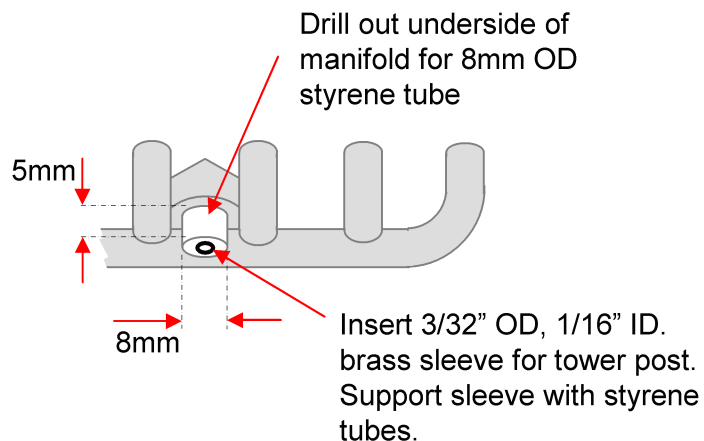
Spades:



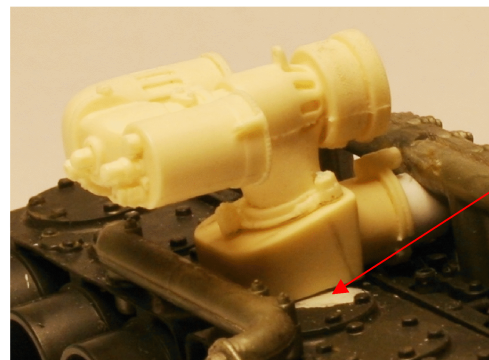
Squeeze flat the end of a $\frac{1}{16}$ " copper tube. Drill $.040$ hole in center. File edges & end to dimensions shown. Drill out end of tube to $.040$ " for 1mm ignition wire.

CARBURETOR MOUNTING

The Pocher carburetor is not to scale. Model Motor Cars offers an outstanding resin model which is. This note describes the mounting to the inlet manifold. Subsequent pages will describe the modifications for the control levers.



Prototype



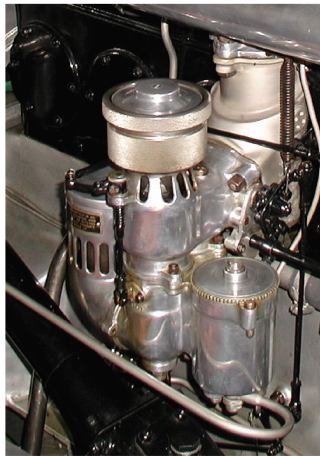
Remove bolt heads on cylinder blocks that are behind the tower

Test fit the assembly!

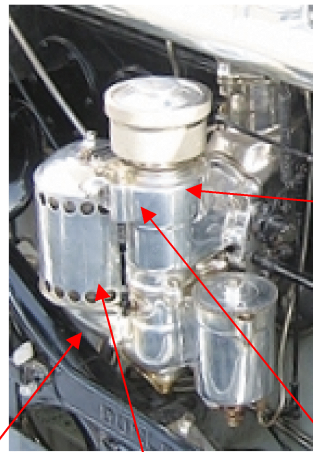
1932 CARBURETOR

In January 1932, the carburetor was changed to the one shown below center. Although structurally similar to the Pocher and Model Motor Cars carburetors, there are distinct differences such as the air cleaner. Control lever arrangements were virtually identical. The following two page note describes the conversion of a Model Motor Cars resin carburetor to something closer to this variant, if that's what you choose to use.

Pre 1932



1932 Prototype



Pipe to
crankcase
(under air
cleaner)

Larger diameter
body. Different
hole pattern

Solid
carburetor
housing.

Longer, solid lever
housing.

Under Construction



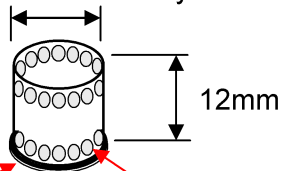
1932 CARBURETOR CONSTRUCTION - 1

1) Remove lip from cover

2) Fill indents and build out the taper. Make 2mm groove under cap.

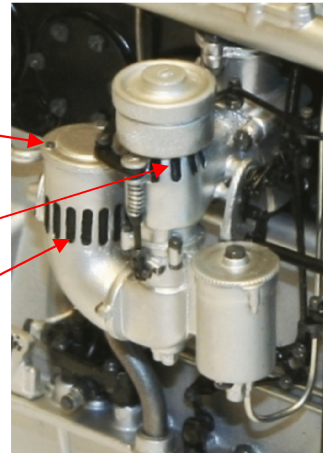
3) Make sleeve to go over resin air cleaner

13mm OD styrene tube



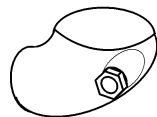
Drill two rows of 16 holes. Holes 3/32" dia.

Add .015" x 14mm OD (13mm ID) ring to bottom

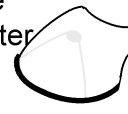


Base is Model Motor Cars Resin Carburetor

4) Add boss for crankcase pipe.
- Fair a 1/8" styrene tube into base. Angle down at 30°.
- Add hex nut made from 1/8" hex tube



5) Make cap to mate with modified center body



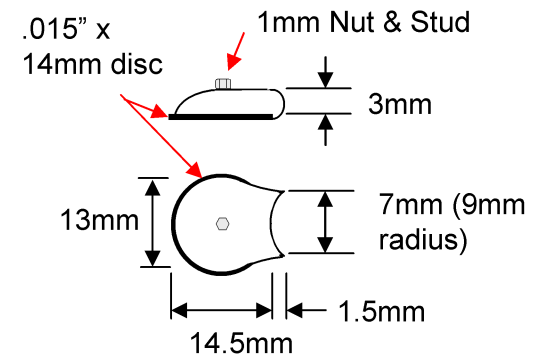
6) Add 1/16" dia. tube, 3mm long. File back side flat. Add fillets to sides.



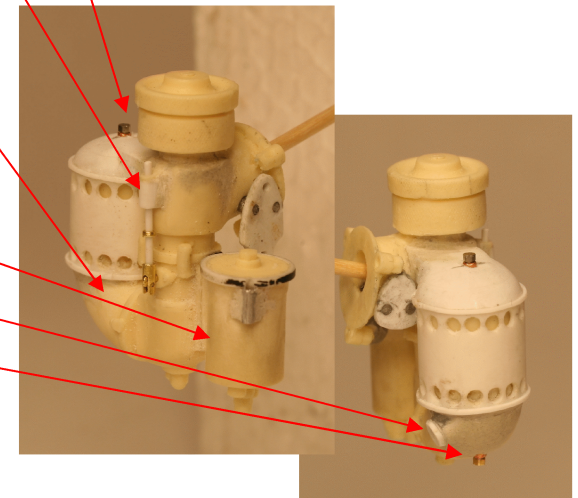
7) Fill and smooth transition from base to sleeve.

8) Cut connecting flange and chamfer edges to allow body to rotate ~15° backwards. Glue in place.

9) Add 1mm nut & stud to underside of base - on centerline of sleeve



Under Construction*

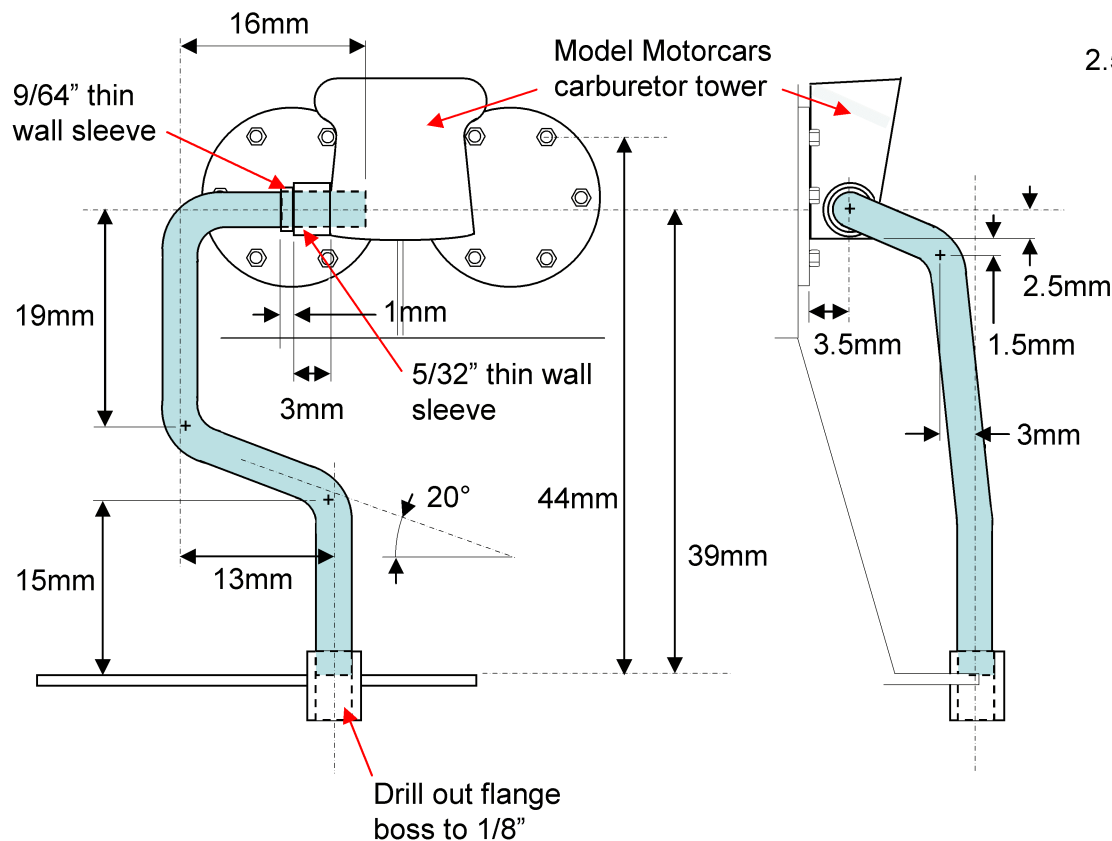


*The making and fitting of the triangular side plates will be covered on a later page

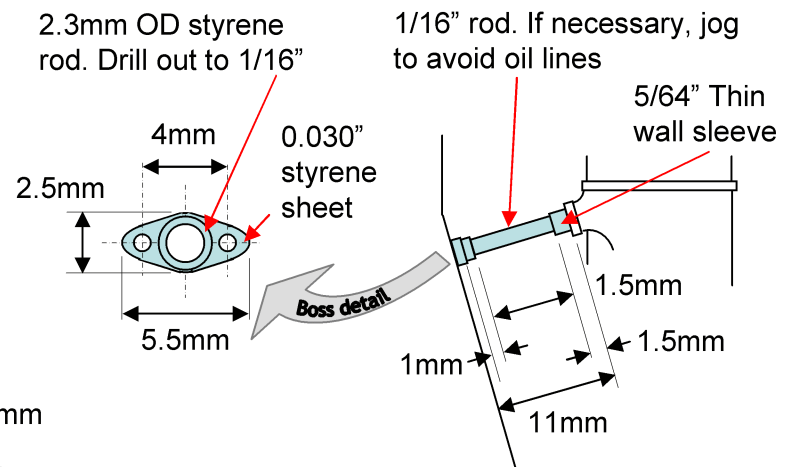
1932 CARBURETOR CONSTRUCTION - 2

Exhaust Heated Throttle Pipe

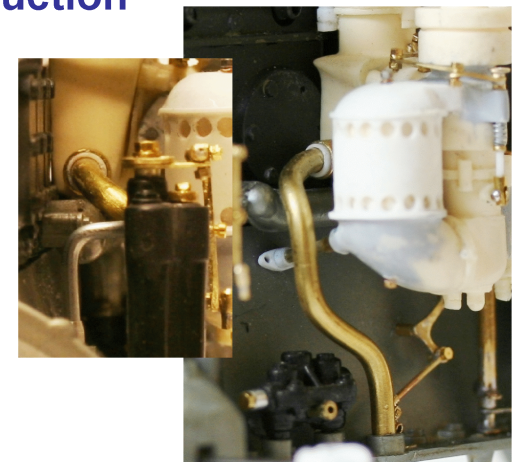
In order to provide clearance around the crankcase-to-carburetor intake pipe, the Pocher exhaust heated throttle pipe must be replaced. A 1/8" diameter brass rod is the basis for the new pipe.



Crankcase-To-Carburetor Intake Pipe



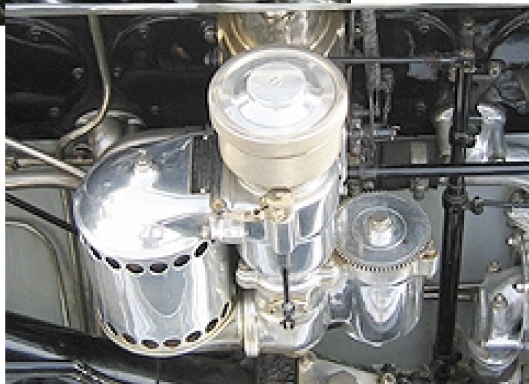
Under Construction



CARBURETOR CONTROLS ASSEMBLY - 1

To successfully add the control linkages, the carburetor must be altered. The following five page note describes how. Since the Pocher carburetor is simply too big, this note is based on a Model Motor Cars carburetor. Although the carburetor shown has been modified to reflect the version installed during 1932, the control linkage arrangement is virtually the same whichever carburetor version is used.

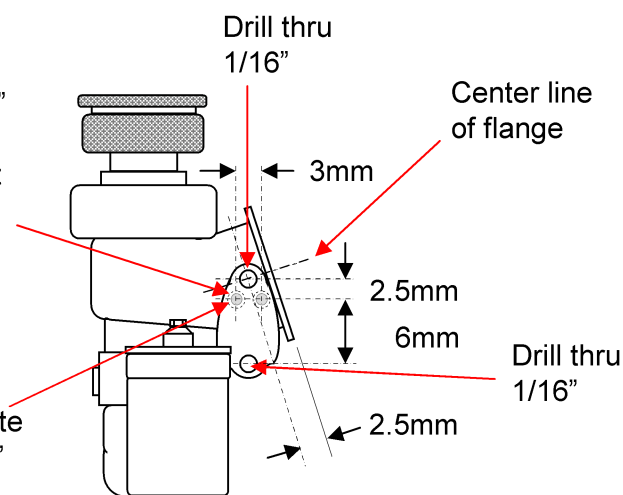
Prototype



Side Plates

Drill two $\frac{3}{32}$ " OD holes, $\frac{3}{16}$ " deep, in carb. body and insert $\frac{3}{32}$ " x 4mm sleeves. Sleeves should protrude 1mm

Drill two $\frac{1}{16}$ " holes in the plate and insert $\frac{1}{16}$ " OD pegs, $\frac{3}{16}$ " long.



Right

Left*



*Cosmetic only. Don't peg, just glue in place

Front Post

28Ga wire coil. 2.5mm long.

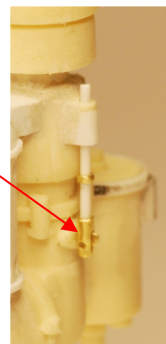
$\frac{3}{64}$ " tube. Flattened end.

Drill .025" dia holes

$\frac{1}{32}$ " x 14mm styrene rod

$\frac{3}{64}$ " x 1mm brass sleeve

$\frac{3}{64}$ " x 3mm brass tube. Saw slot 1mm wide, 1.5mm deep



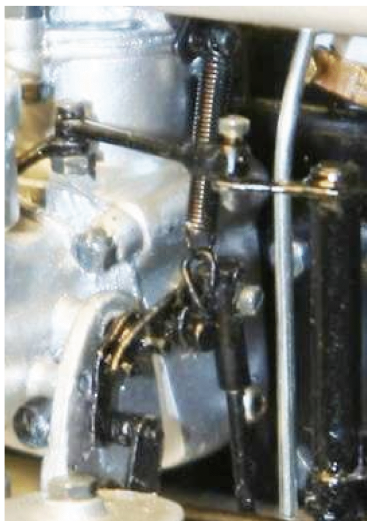
Drill $\frac{3}{64}$ " hole in center of boss

CARBURETOR CONTROLS ASSEMBLY - 2

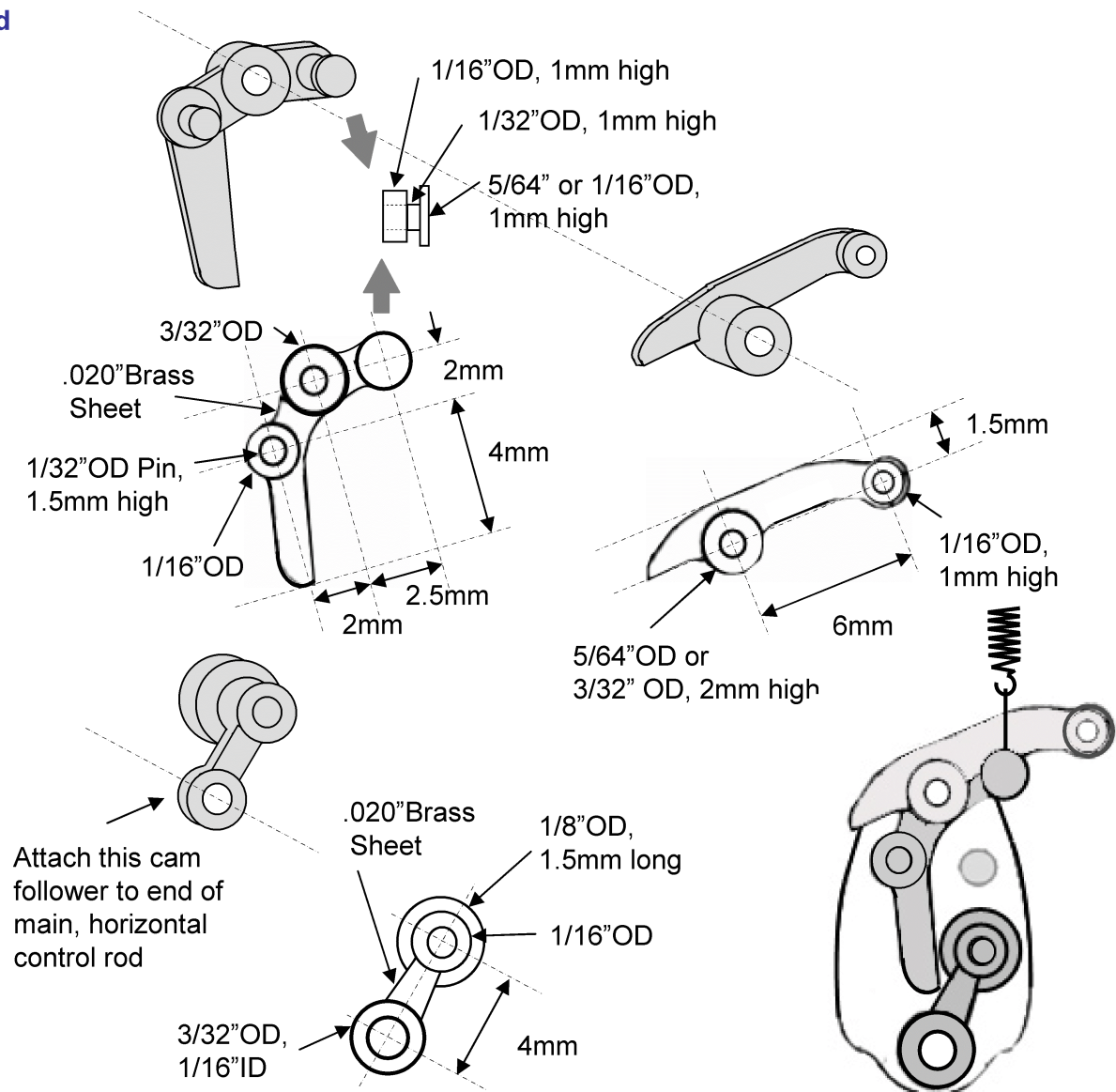
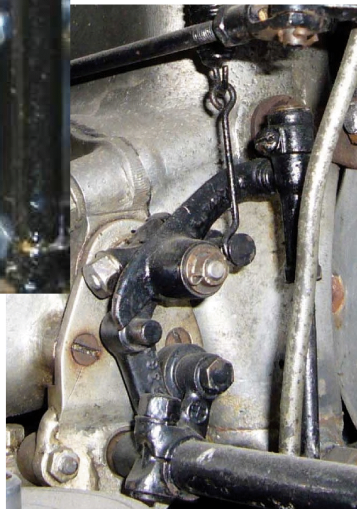
The butterfly valves on the carburetor are adjusted through a system of levers and cams. This page provides dimensions and arrangements for those levers and cams.

Butterfly Levers

Completed model



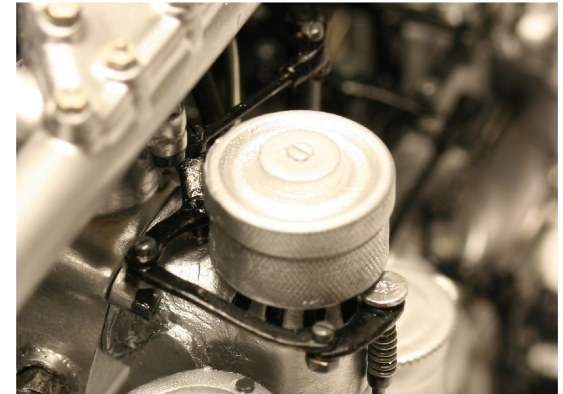
Prototype



Top Linkage & Pivot



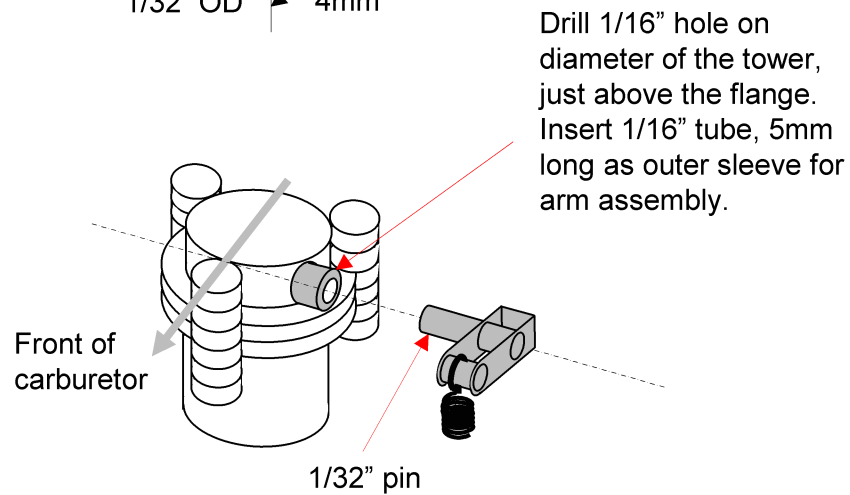
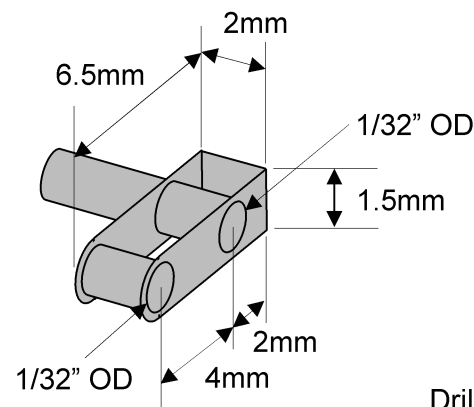
(pre-1932 Carburetor)



CARBURETOR CONTROLS ASSEMBLY - 4

Tower Arm & Spring

Prototype



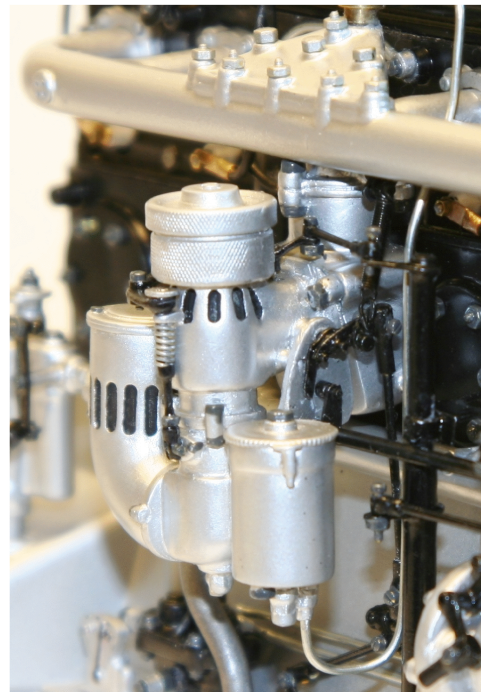
CARBURETOR CONTROLS ASSEMBLY - 5

And when it all comes together

Pre 1932 Prototype



Pre 1932 Model



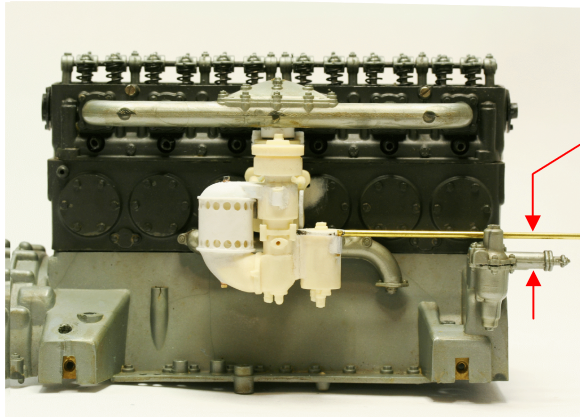
**1932 Model
Under Construction**



GOVERNOR & DISTRIBUTOR PLATFORM

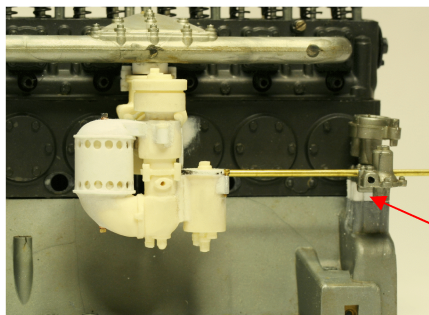
With the side plate installed on the carburetor, the control arm across the top of the governor/distributor platform should be level and parallel to the engine centerline. To achieve that, modifications are needed to the platform. The solid control arm support also needs to be replaced by a tube.

The governor/distributor platform is clearly out of position in the Pocher kit.



Control arm and support are out of alignment

Raising the platform 3mm fixes the problem.



Raised platform

Construction

Use styrene sheet to add 3mm to base of platform

Re-use Pocher end flange; cut off old lever arm, then drill out flange for 3/32" tube

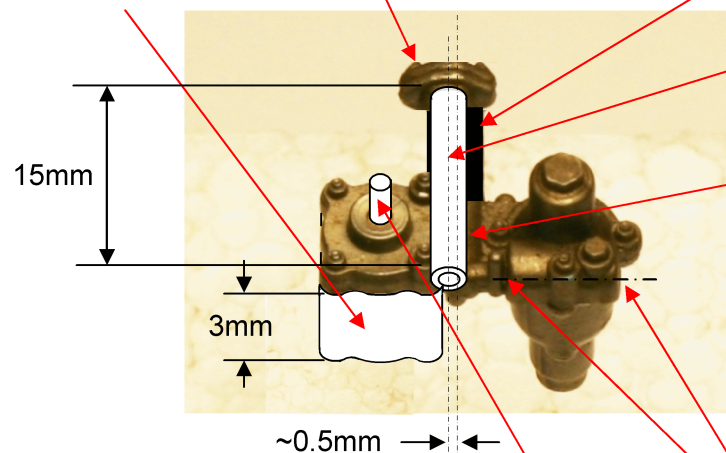
Cut off original Pocher rod, then replace with 3/32" brass tube, 1/16" ID

Grind off the top of the Pocher rod, then groove molded part to take 3/32" tube.

Adjust depth of groove so that the control arm is level.

Remove fake lever arm and drill a 3/64" through hole

Use peg to marry distributor, platform and engine block



New centerline

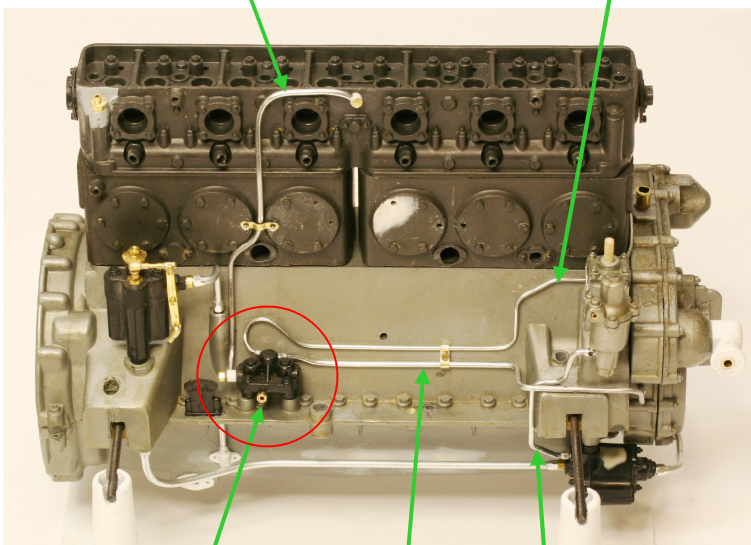
Old centerline

OIL RELIEF VALVE

The Pocher kit leaves out a number of key oil lines as indicated below by the green arrows. Modifying the Oil Relief Valve is the starting point and key to adding the extra lines. It's critical you make these changes and install the oil lines before installing the engine controls.

Note: on prototypes, the vacuum pump line comes off the rear face of the innermost post of the relief valve. Photographs then show this line looping downward and back between the relief valve and the oil indicator (and then running along the crankcase flange) or looping back over the valve (as on this model). The first configuration is shown on early RR drawings, but the second is cleaner and simpler.

Relief Valve to Cylinder Head Relief Valve to Vacuum Pump

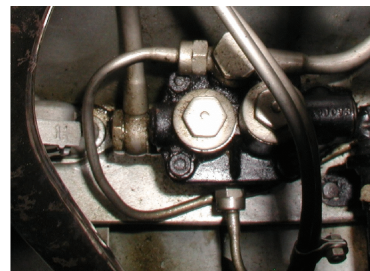


Relief Valve to Timing Gear Case

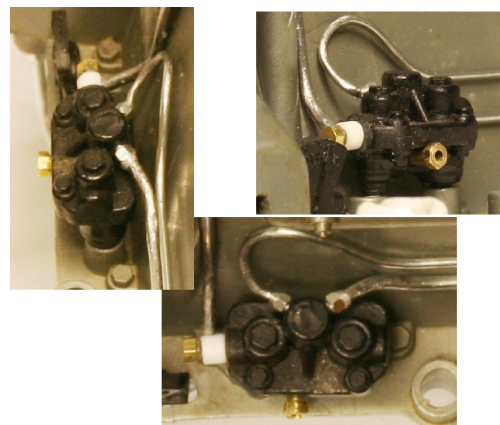
Oil pressure line to Instrument Panel (only the fitting is shown here)

Oil Governor to Oil Pump

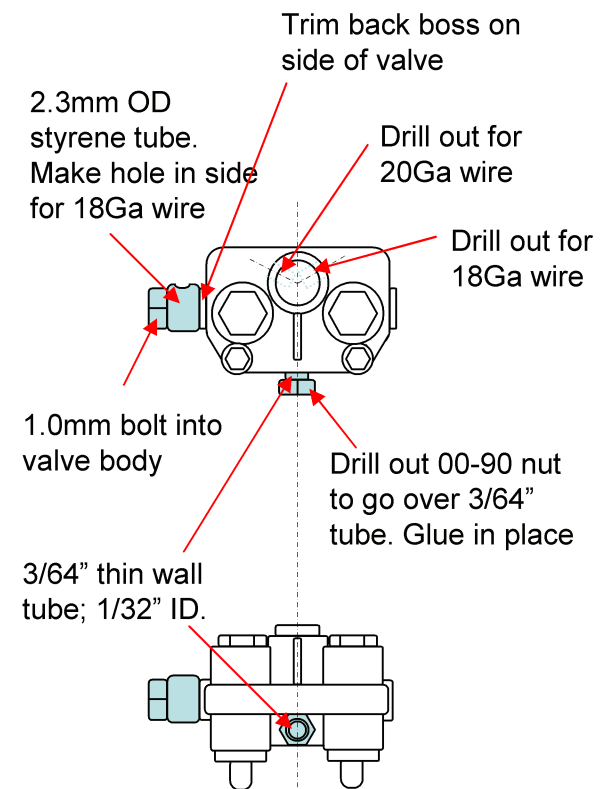
Prototype



Under Construction

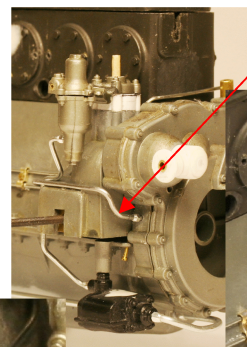
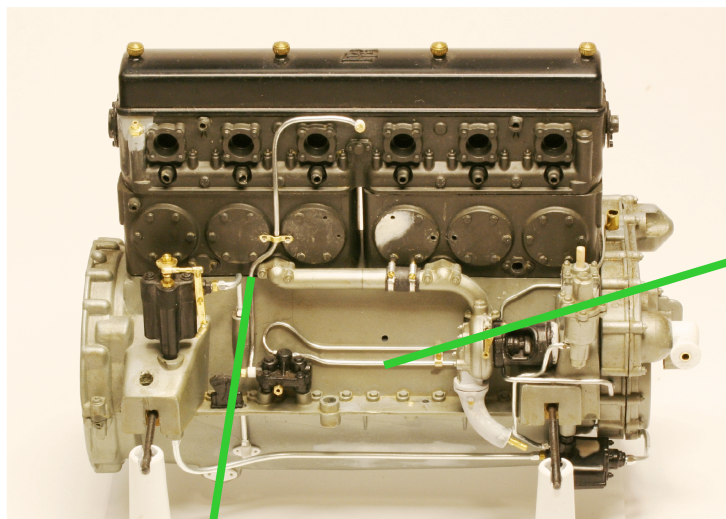


Modifications to Pocher Valve

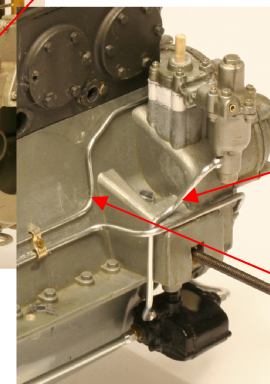


ENGINE OIL LINES

Stiff aluminum wire was used for the oil lines on this model. It is relatively easy to shape to the routings shown. The pictures and drawings provide information on some of the details.



18Ga wire, Detailmaster #4 fitting at Timing Gear Case



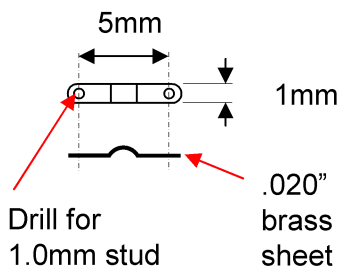
18Ga wire, Detailmaster #4 fittings at both ends

20Ga wire. Line terminates at the vacuum pump



Cylinder Block Bracket

(see top left picture)



Drill for 1.0mm stud

.020" brass sheet

Crankcase Bracket

5/64" thin wall brass tube

3/64" square rod

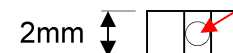
1/16" thin wall brass tube

Solder together and grind flat



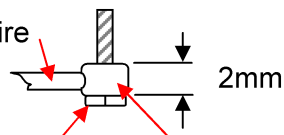
Cut to 2mm wide

Drill 1/32" hole for 0.8 mm bolt



Remove the center molded boss. Drill 1/32" hole through center for 1.0mm bolt.

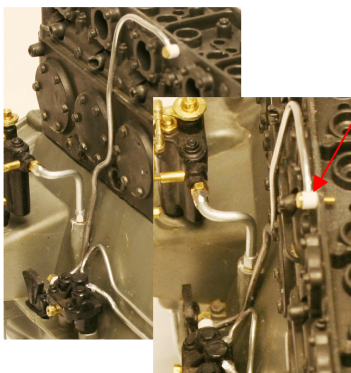
20Ga wire



2mm

1mm bolt. Grind down head for inlet manifold clearance

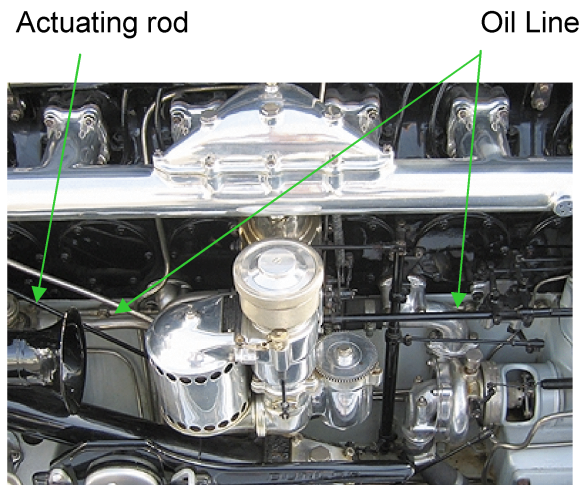
2.3mm OD styrene tube



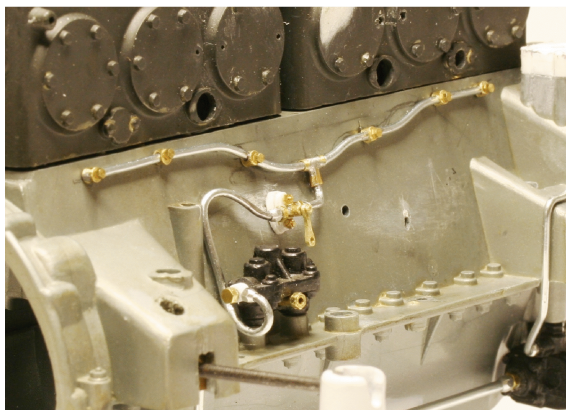
CYLINDER WALL EXTRA OIL SUPPLY

From July 1931 on, engines had extra oil supplied to the cylinder walls during start up. The supply line and regulating valve were on the offside crankcase wall. Through levers and rods, the valve was actuated by the starting carburetor lever on the steering wheel.

Prototype

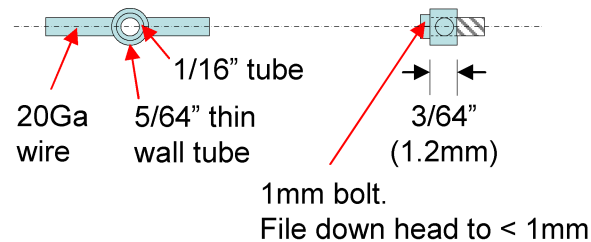


Under Construction

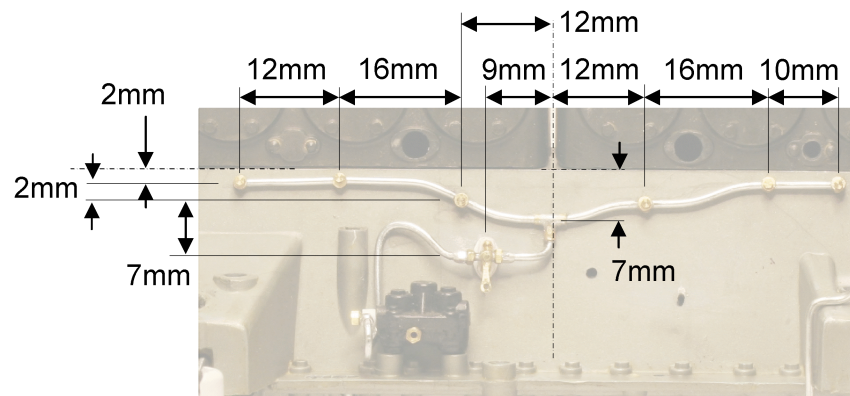


Cylinder Feed Points

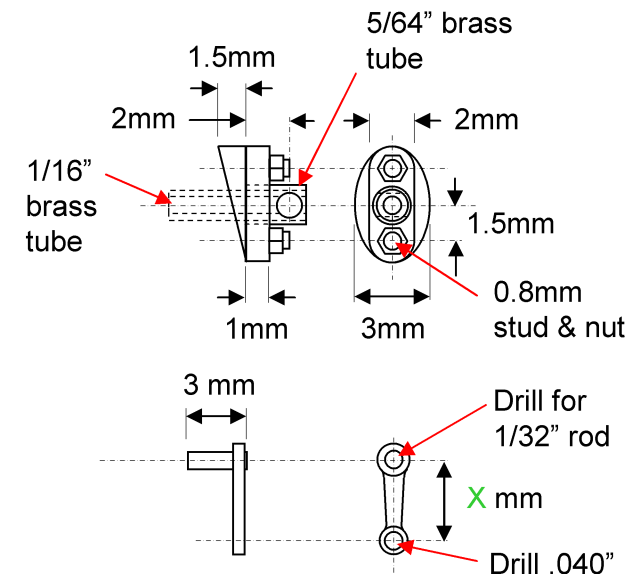
Insert 1/16" tube into 5/64" thin wall tube.
Drill .042" hole thru sides for 20Ga wire (the oil supply line).
Glue 20Ga wire in place.
Drill thru end of 1/16" tube for bolt shaft (bolts will pin oil line to crankcase wall).
Cut off & grind tubes to correct height



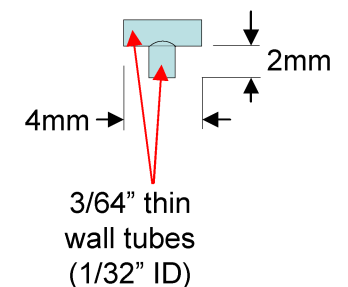
Positioning



Valve & Lever



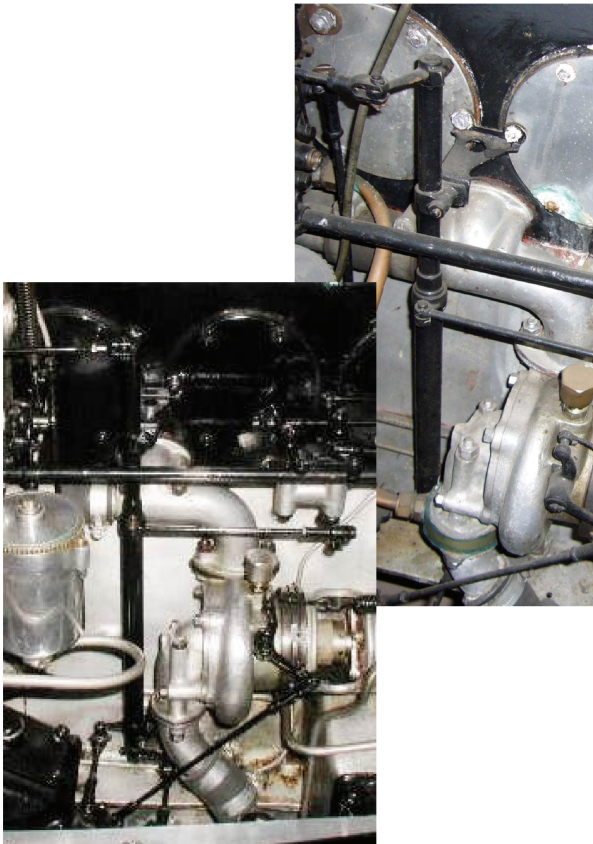
'T' Piece



CONTROL SHAFT - 1

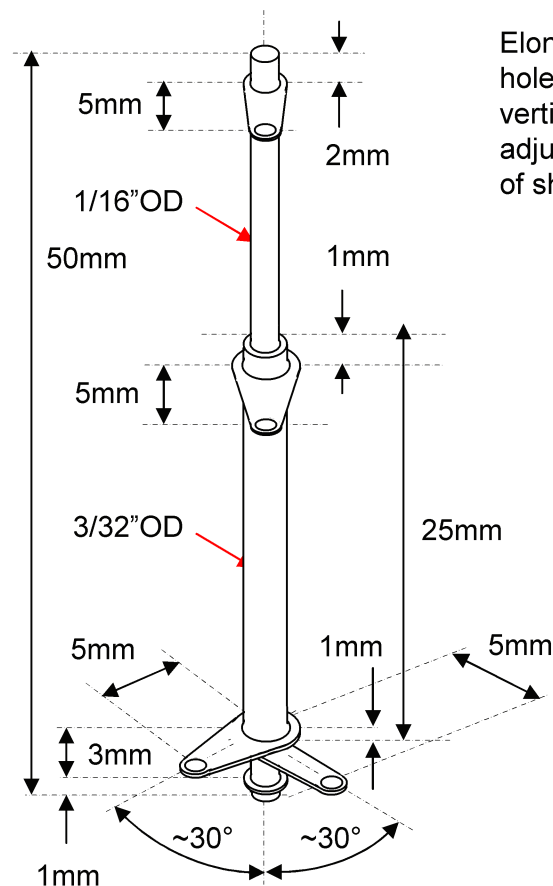
Once the carburetor has been modified and oil lines installed, the rest of the control system can be built.
The control shaft provides the link between the controls on the steering column and the carburetor and ignition levers.

Prototypes

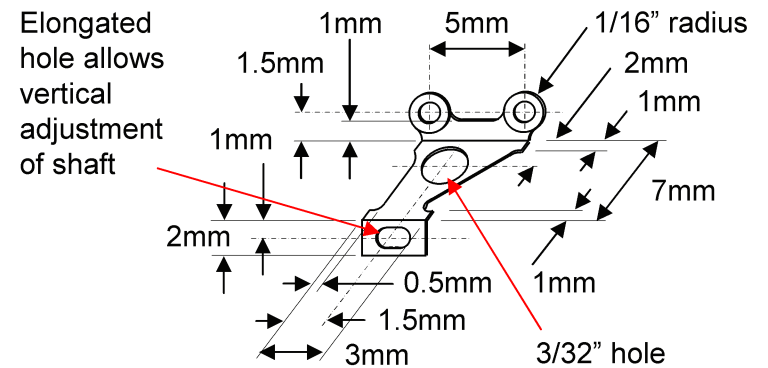


Details & Dimensions

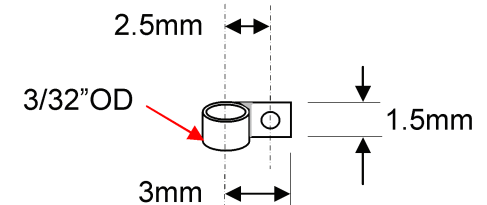
Shaft



Support Bracket



Attachment Bracket



Arms and brackets are from .020" sheet

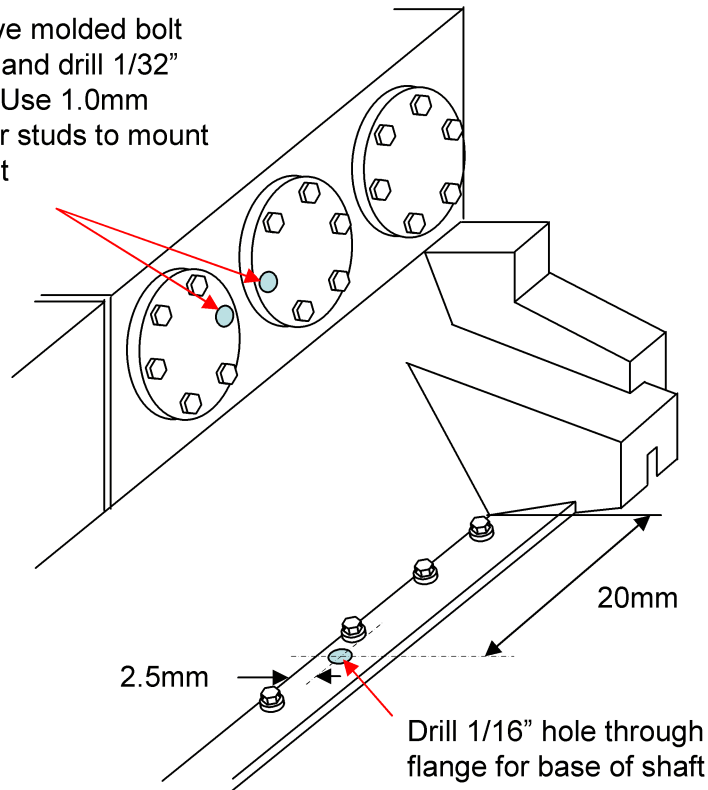
Drill out all bolt holes to .040" (#60) and use 1.0mm bolts and nuts

CONTROL SHAFT - 2

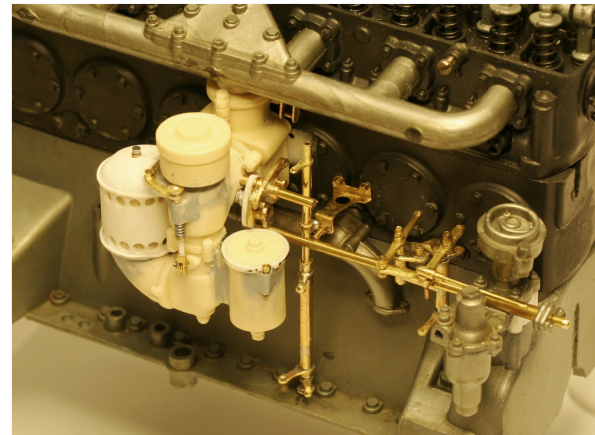
Positioning of the base of the shaft on the crankcase flange is important so as to avoid interference with the long horizontal shaft that runs between the carburetor and distributor platform.

Location

Remove molded bolt heads and drill 1/32" holes. Use 1.0mm bolts or studs to mount bracket

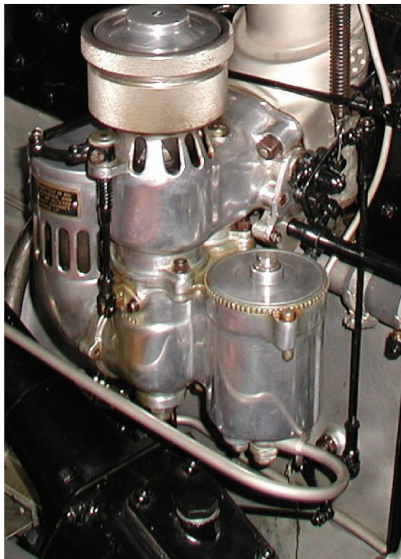


Under Construction



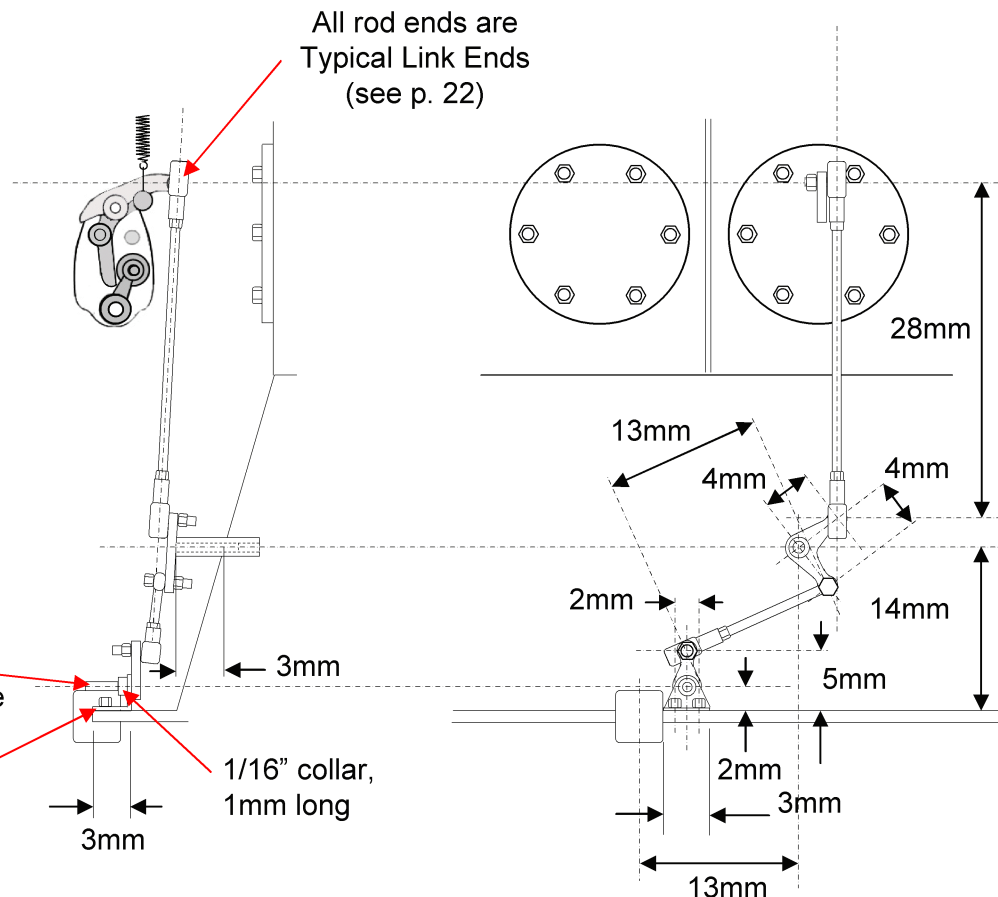
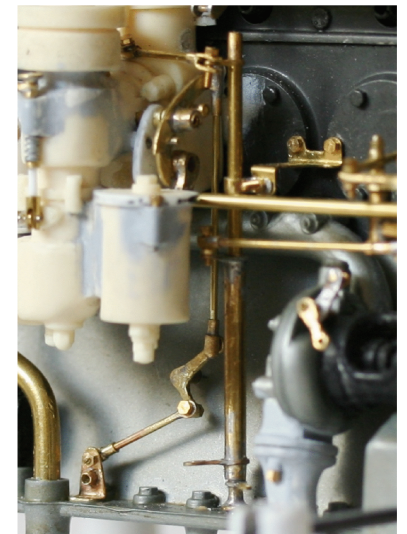
CARBURETOR BUTTERFLY VALVE LINKAGE

Prototype



1/32" shaft
Attaches to underside
of steering column

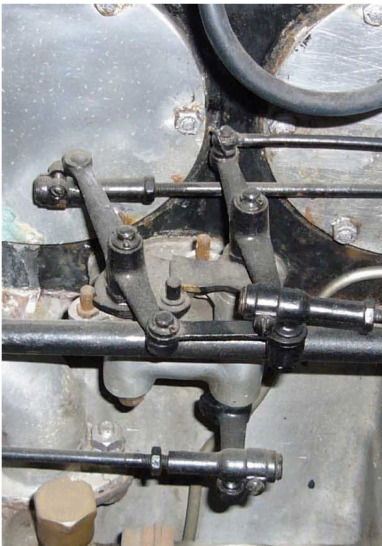
Bracket from
0.020" sheet

1932 Model
Under Construction

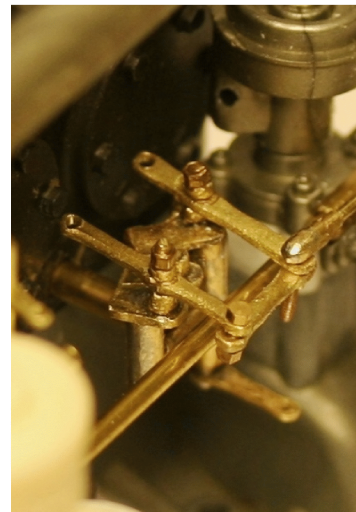
IGNITION SYNCHRONIZING CONTROL BRACKET - 1

The ignition synchronizing control bracket, (Rolls-Royce terminology) is one of the trickier components of the engine controls system to model. This two-page note provides details and dimensions. To improve realism, the two cam plates are included (but not the stops).

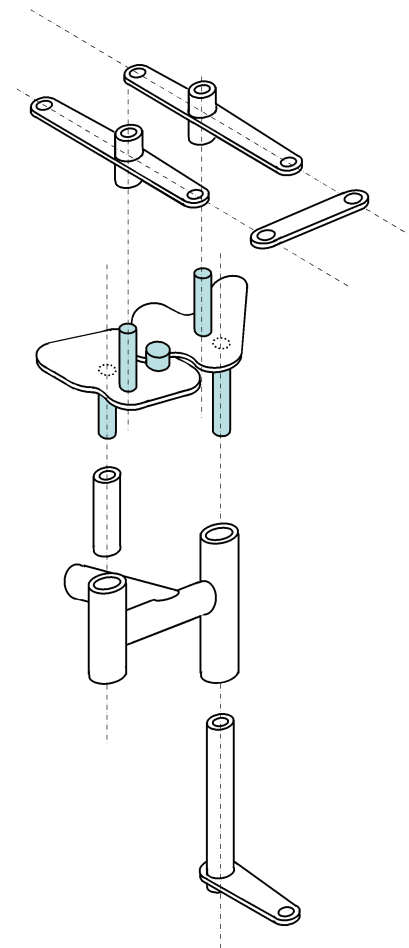
Prototype



Under Construction

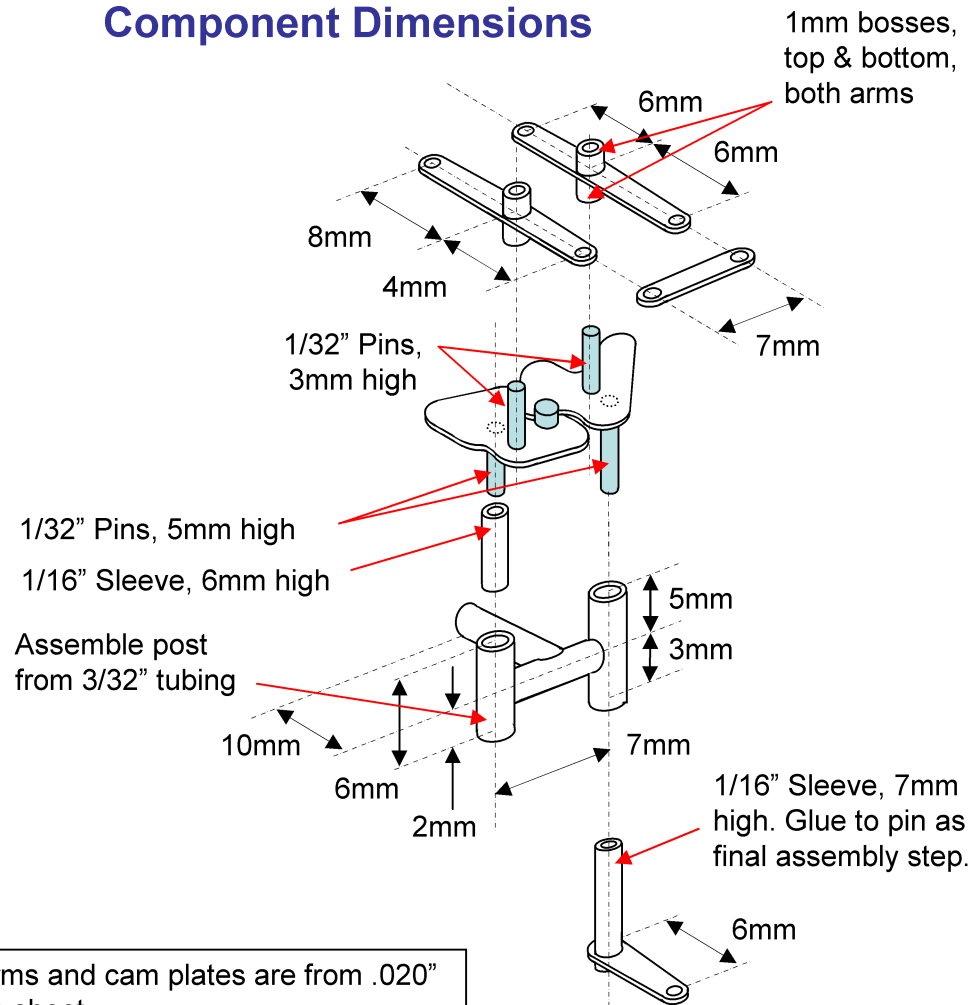


The Components



IGNITION SYNCHRONIZING CONTROL BRACKET - 2

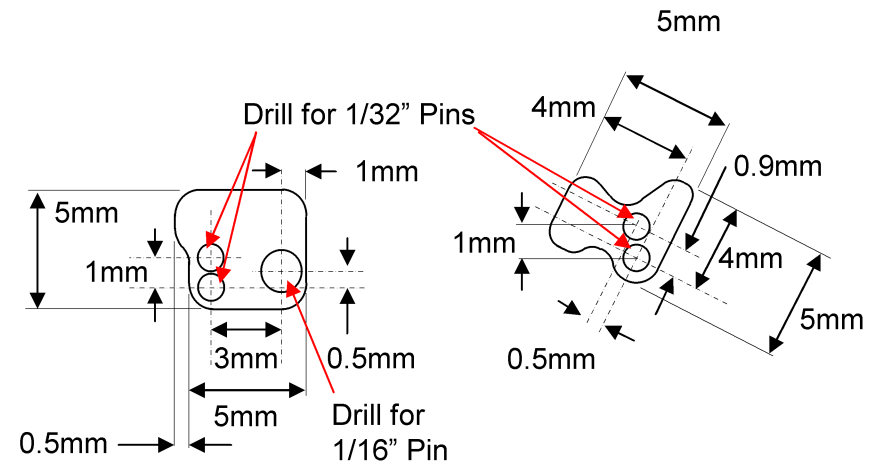
Component Dimensions



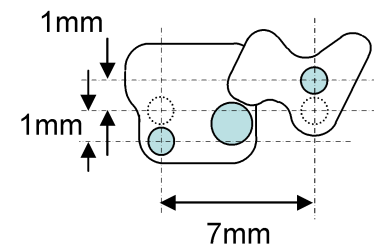
All arms and cam plates are from .020" brass sheet

Drill out all bolt holes to .040" (#60) and use 1.0mm bolts and nuts

Cam Plate Dimensions



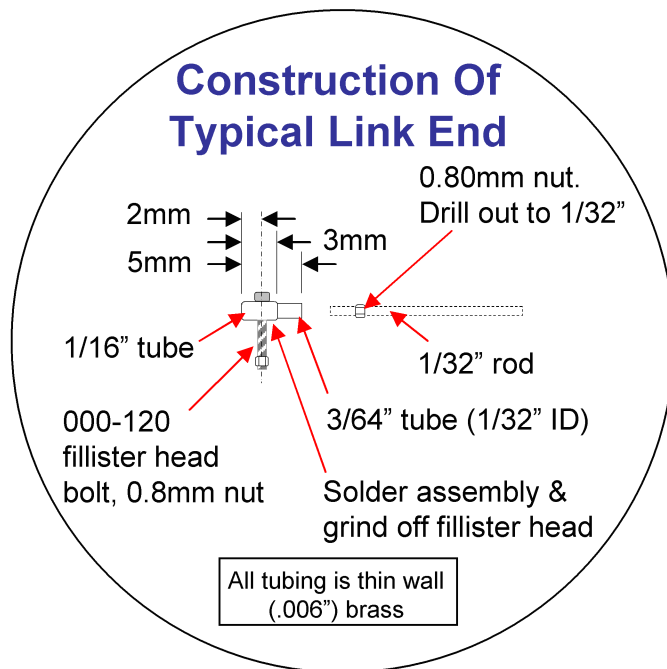
Cam Plate Arrangement



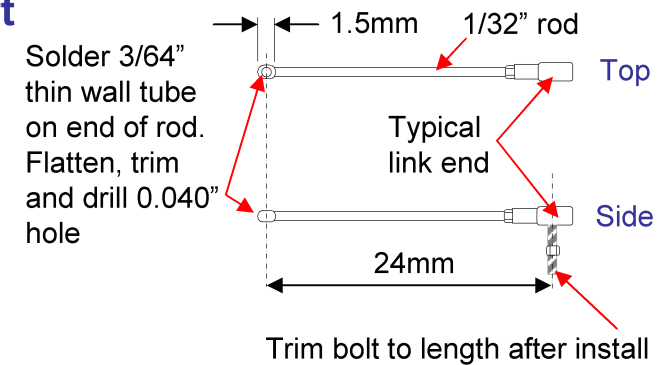
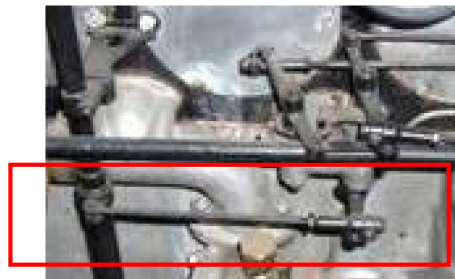
CARBURETOR & IGNITION CONTROL LINKS - 1

The following two page note describes and dimensions the various linkages between the carburetor, control shaft, ignition synchronizing bracket and governor.

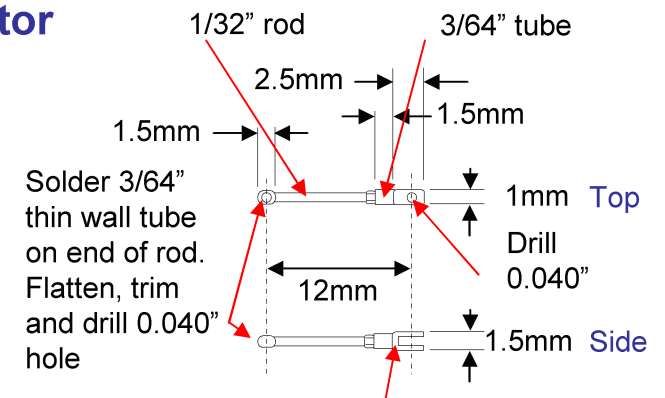
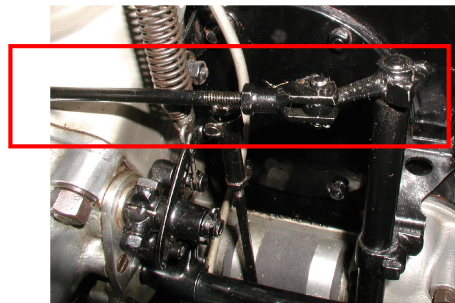
Construction Of Typical Link End



Ignition Synchronizing Bracket To Control Shaft

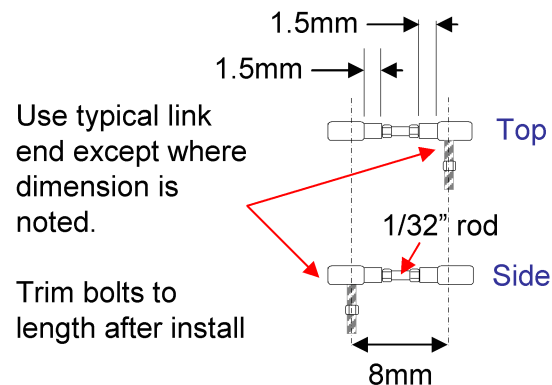
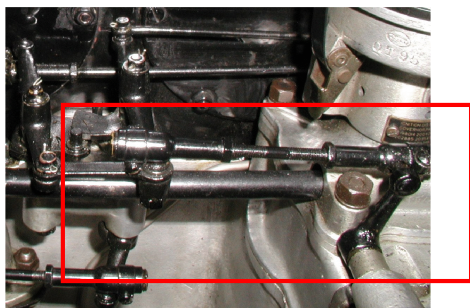


Control Shaft To Carburetor



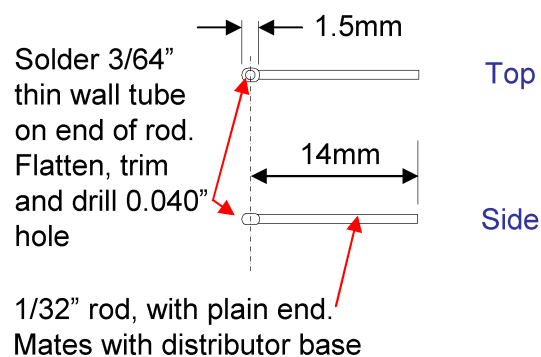
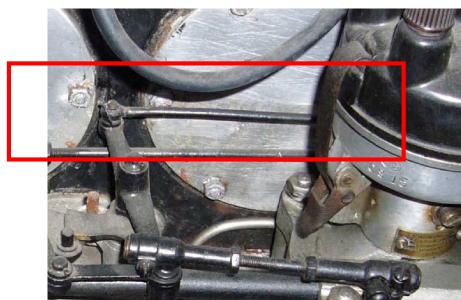
CARBURETOR & IGNITION CONTROL LINKS - 2

Synchronizing Bracket To Governor

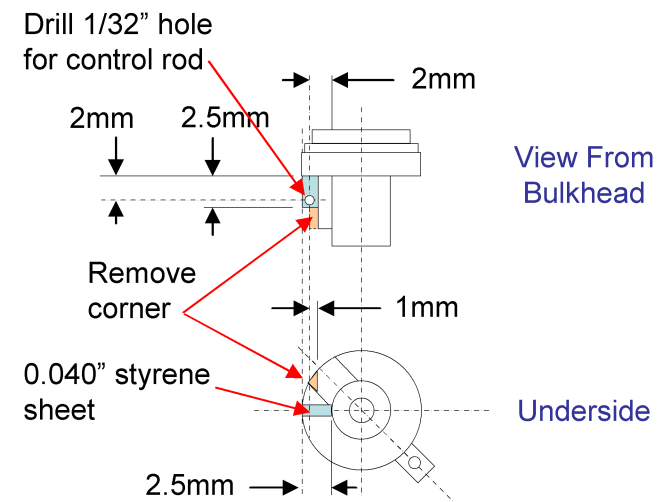


Synchronizing Bracket To Distributor

Control Rod



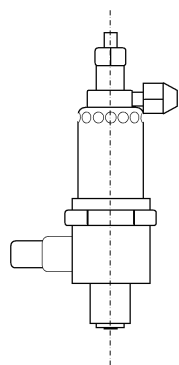
Distributor Base Modifications



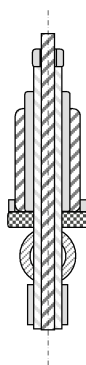
STARTING CARBURETOR

The Pocher version of the Starting Carburetor is a pretty good approximation. However, it lacks detail and, more importantly, doesn't provide for the fuel line or the control rod. Here's a more accurate alternative:

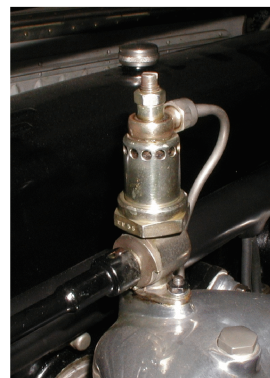
External View



Cross Section



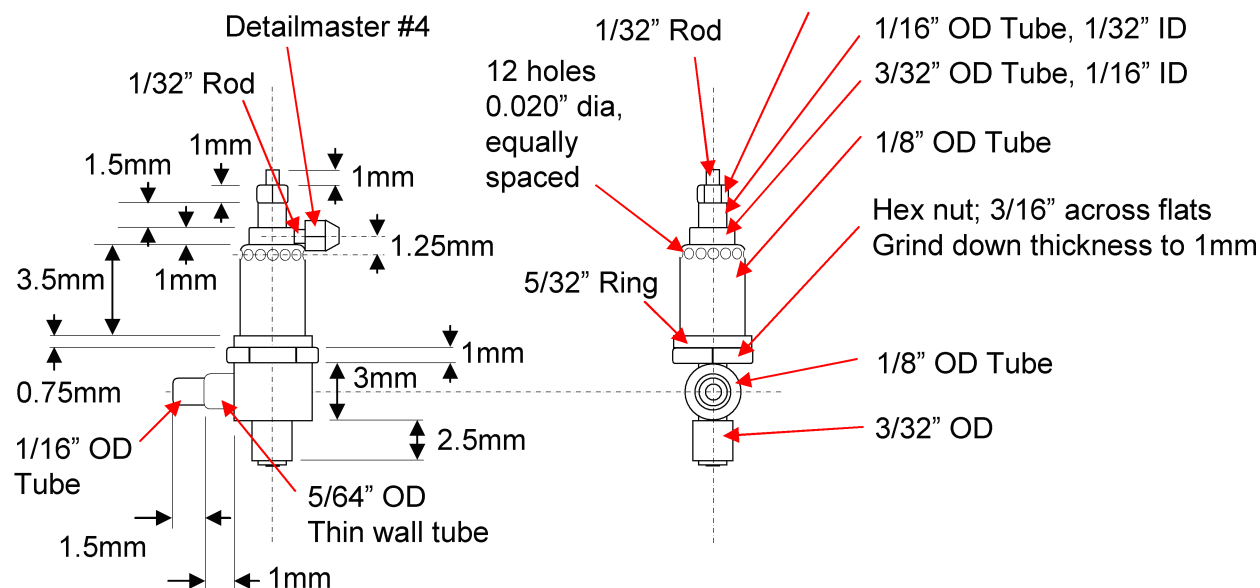
Prototype



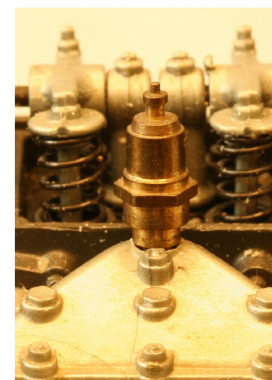
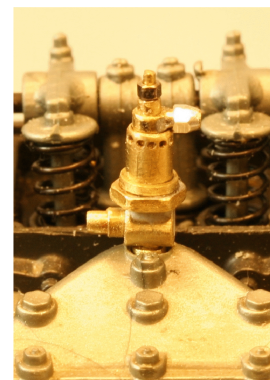
JRH Model



Dimensions & Parts



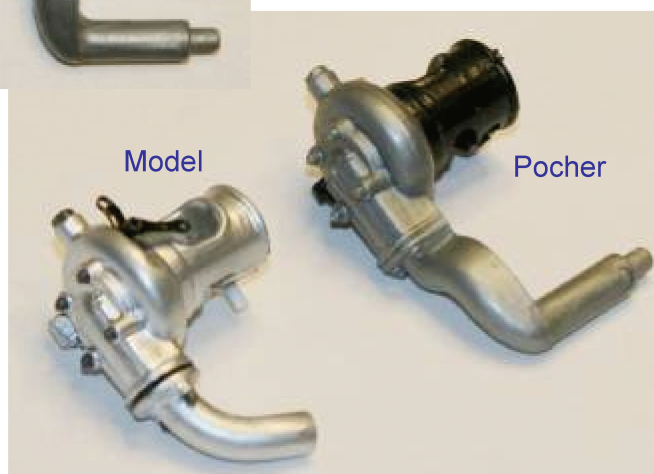
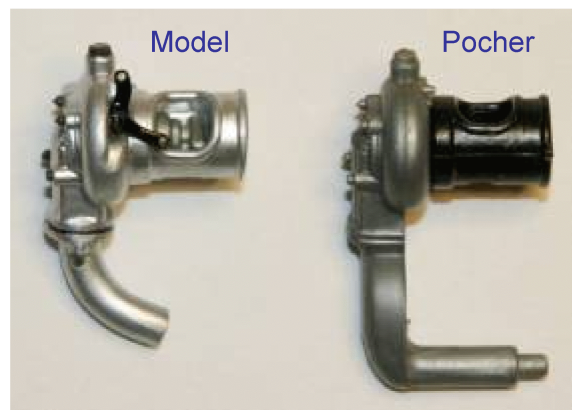
Pocher



WATER PUMP

Three major modifications were made to the Pocher water pump:

- The pump housing was carefully milled out to accommodate the control arms.
- The opening in the pump housing was reoriented to face about 45° to the horizontal; similar to the prototypes. This required cutting and repositioning the arm on the back of the housing that mates with the water manifold. The underside of the housing also was modified to fit the mounting boss on the crankcase.
- The inlet pipe (from the bottom of the radiator) was replaced (with a bent brass rod and styrene flanges) to match the prototypes and represent a more realistic design.



Prototype



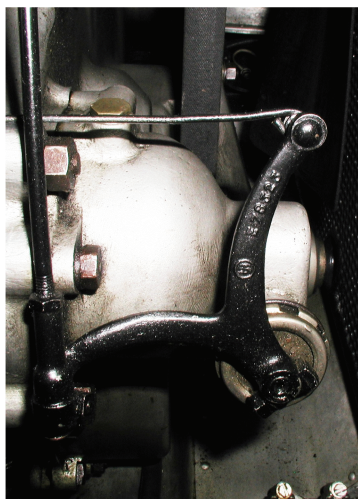
Model



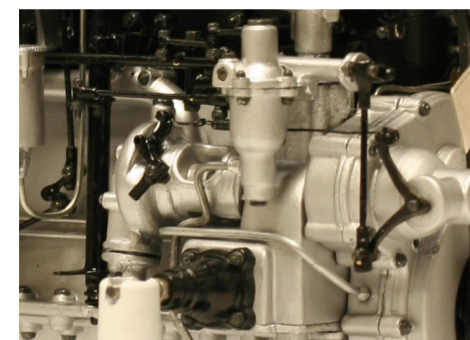
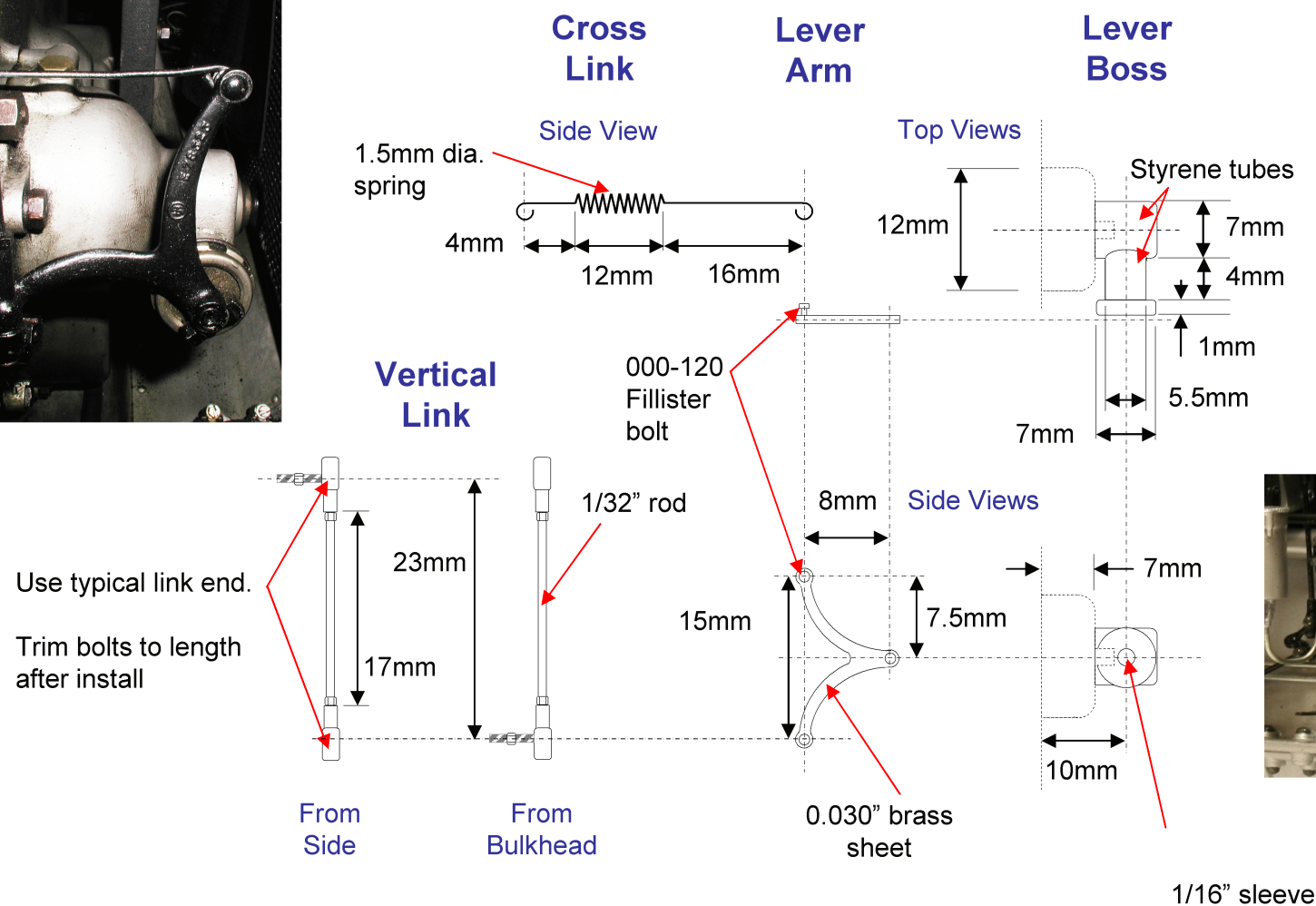
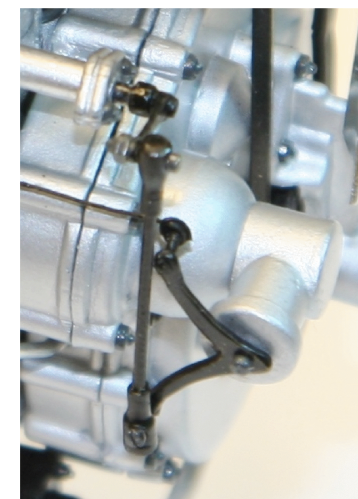
TIMING GEAR LEVER & CONTROL LINKS

Adding the timing gear lever and controls requires first enlarging and extending the boss on the front timing gear cover (shown on the right).

Prototype



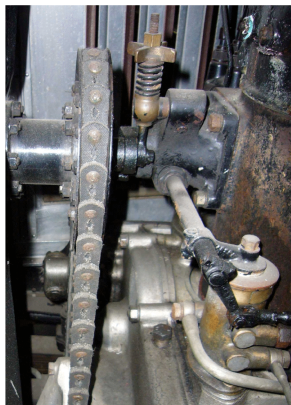
Model



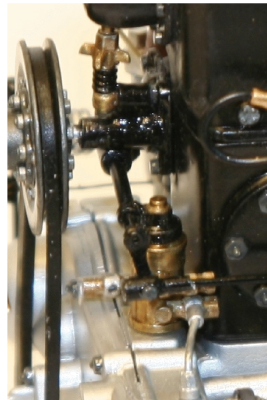
FRONT CONTROL CROSS ROD

The front control rod is a key part of the linkage between the ignition synchronizing levers (adjacent to the distributor) and the magneto. To accommodate the rod, a support tube must be added to the underside of the fan mount, another added to the top of the vacuum pump (see the vacuum pump note) and the vacuum pump moved back on the timing gear casing.

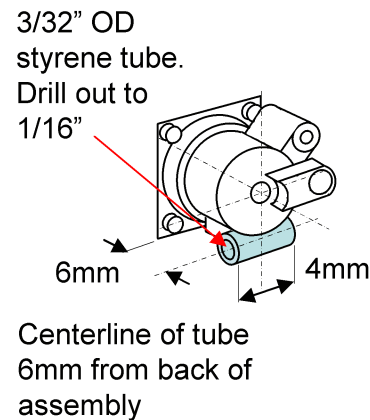
Prototype



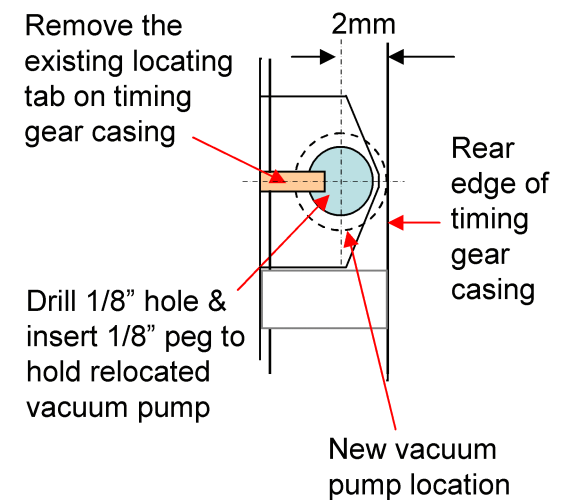
Model



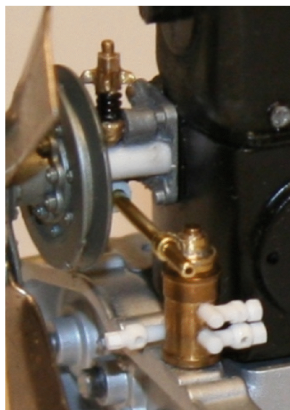
Add Support Tube



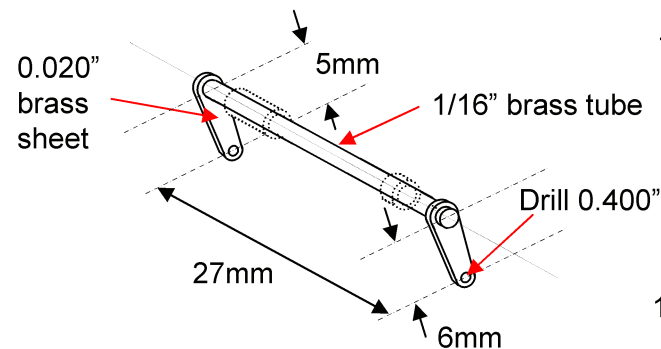
Relocate Vacuum Pump



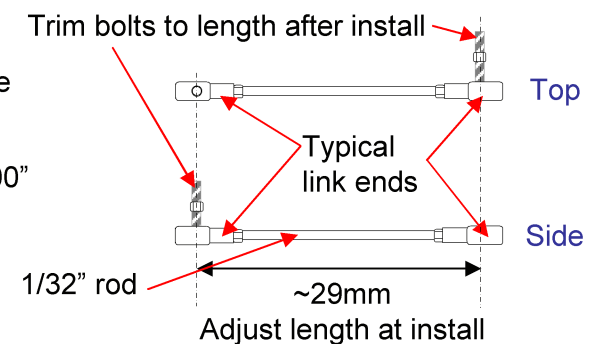
Under Construction



Make Cross Rod & Arms



Make Linkage Rod



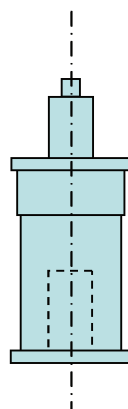
VACUUM PUMP

The vacuum pump is integral to any super-detailing of the engine. From the pump, there is a vacuum line to the Autovac and another oil line to the gear casing. The pump also provides support for the control rod that runs across the front of the engine.

Prototype



Pocher



1/16" styrene tubes 5mm long. Drill body, then insert 1mm deep.

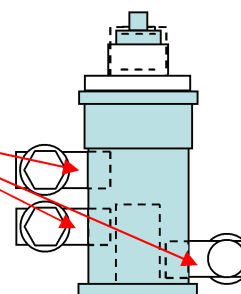
Model Construction

For the control rod support, drill out and file the pieces to fit. Then solder all three pieces together.

5mm OD washer. Drill out to 1/8" dia.

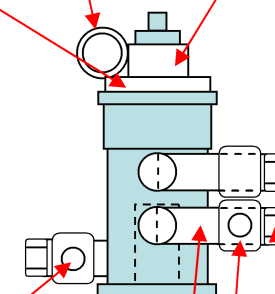
3/32" tube 3mm long

1/8" tube x 3mm. Drill out to 7/64"



(From the bulkhead)

Drill .040" for 18Ga vacuum line



(From the nearside)

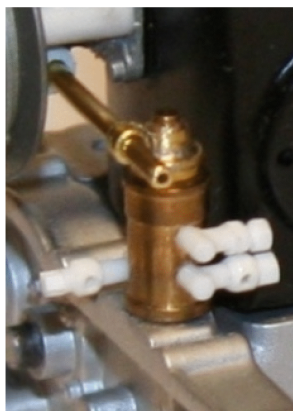
1/16" styrene tube 5mm long. (typical)

3/32" sleeve 2mm long. (typical) Drill .032" for 20Ga oil line

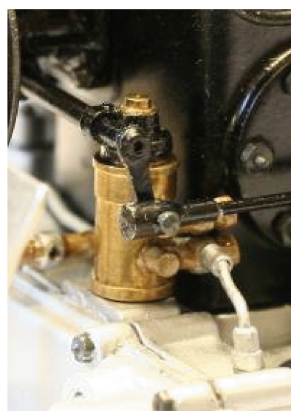
1/16" styrene hex rod, 2mm long. (typical)

Chassis Model

Control Rod – Under Construction

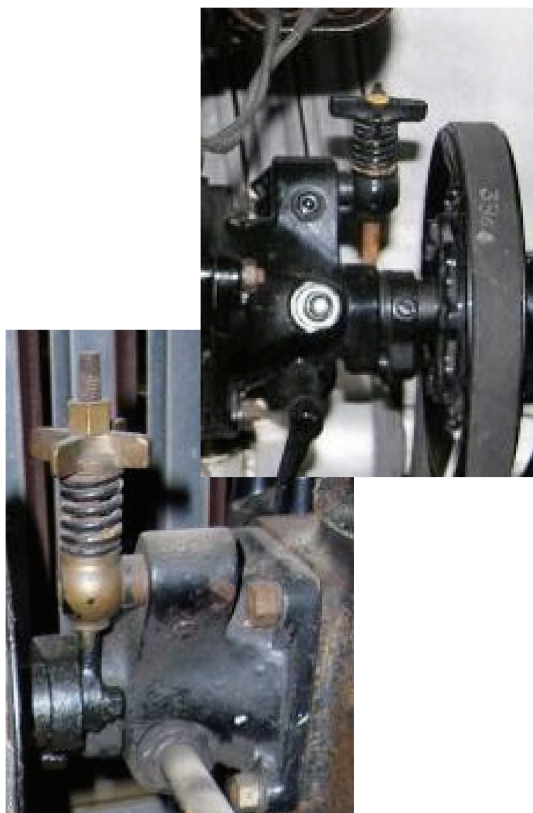


Finished ... except for final vacuum line

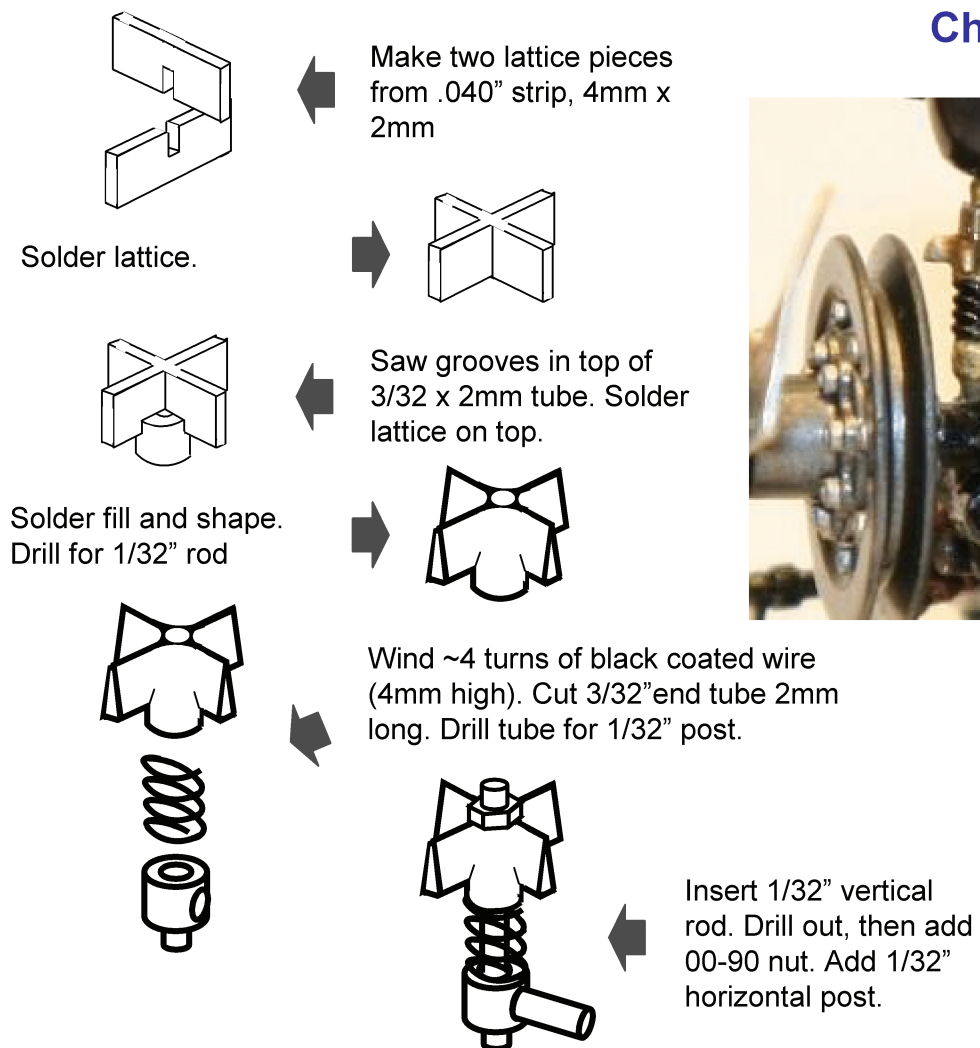


FAN BELT TENSIONER

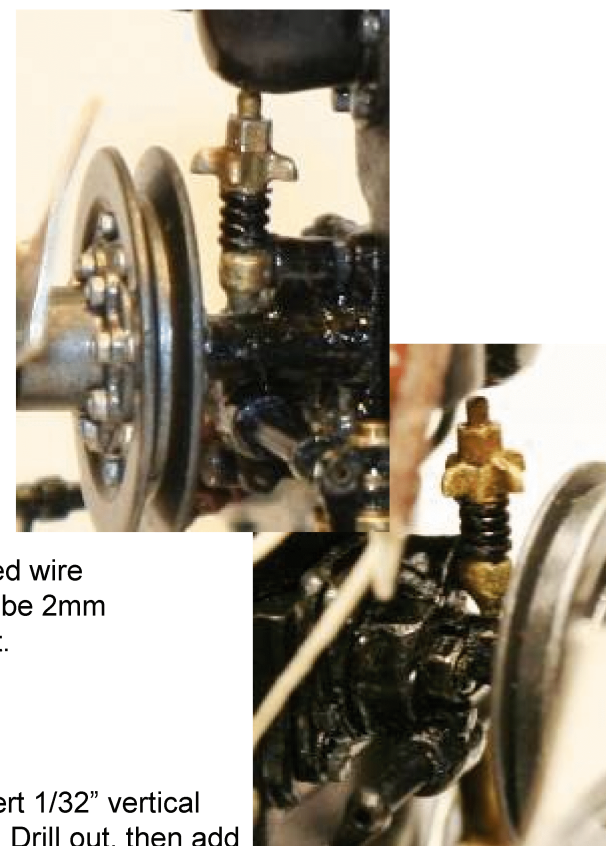
Prototypes



Model Construction

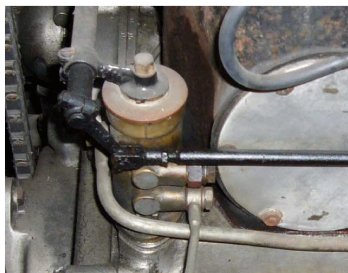


Chassis Model

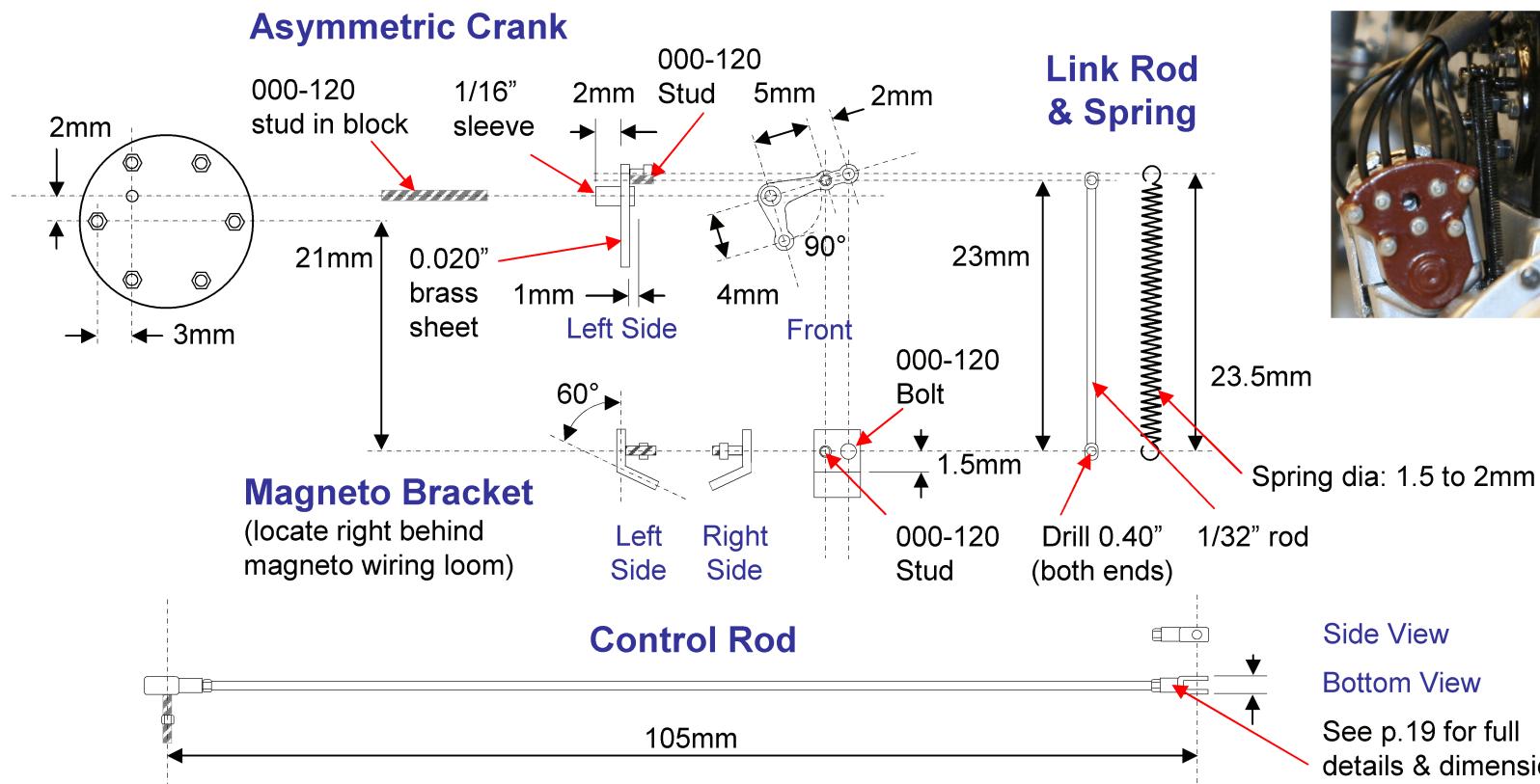
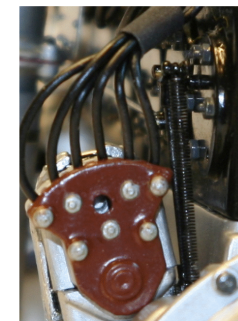
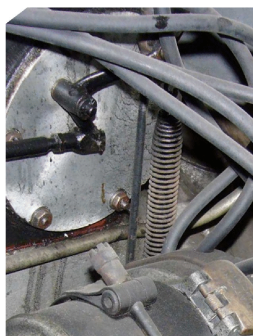
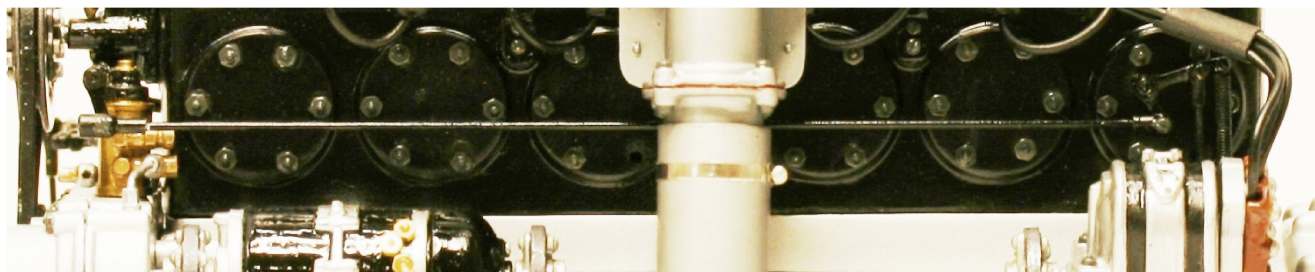


MAGNETO CONTROL LINKAGE

Prototypes

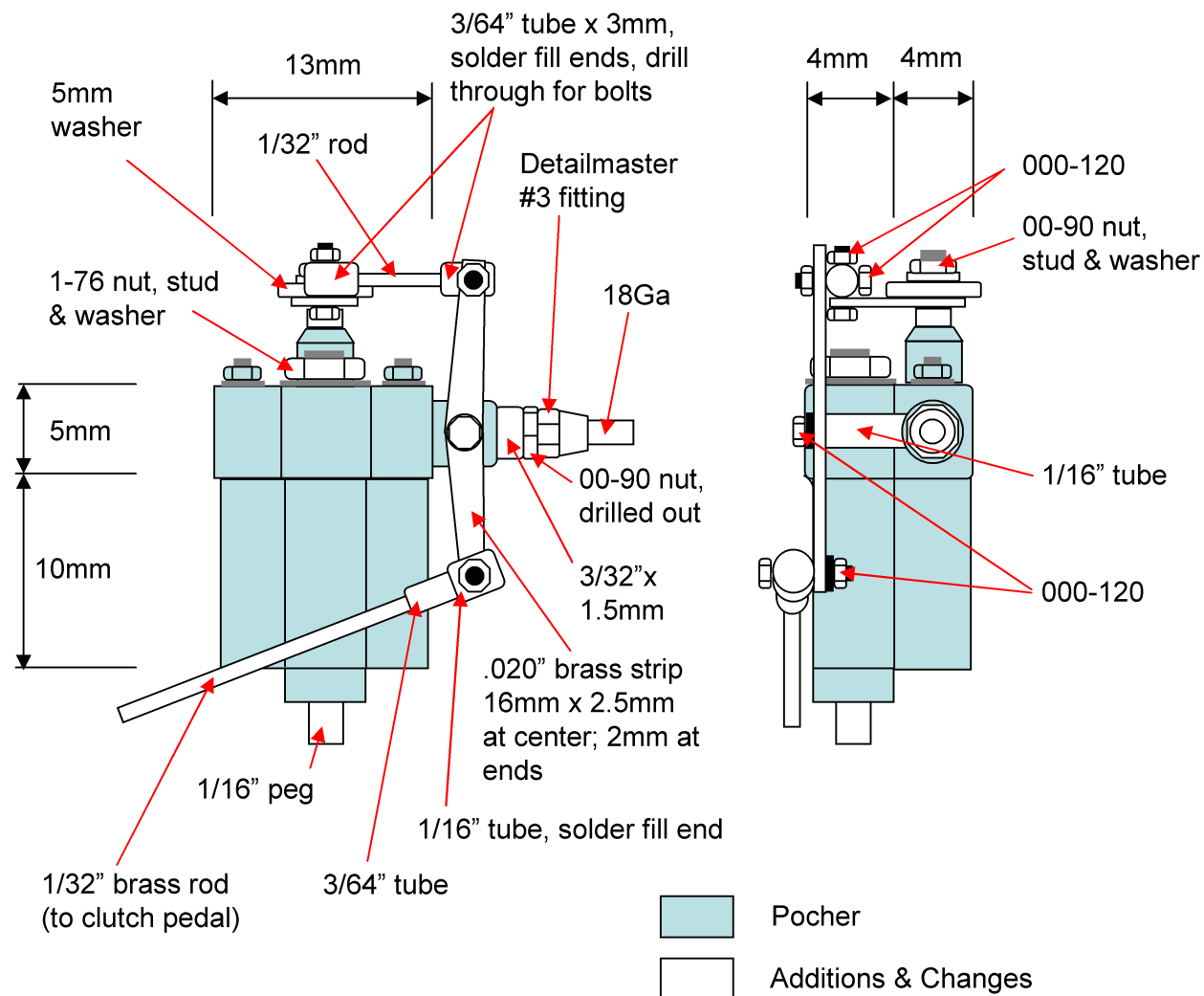


Model



OIL FILTER

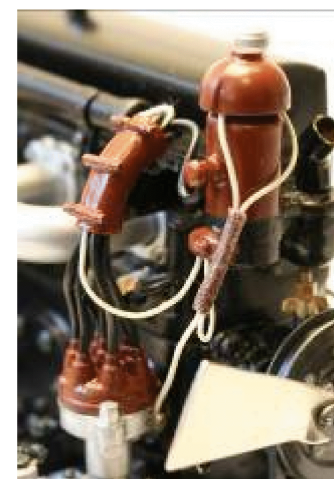
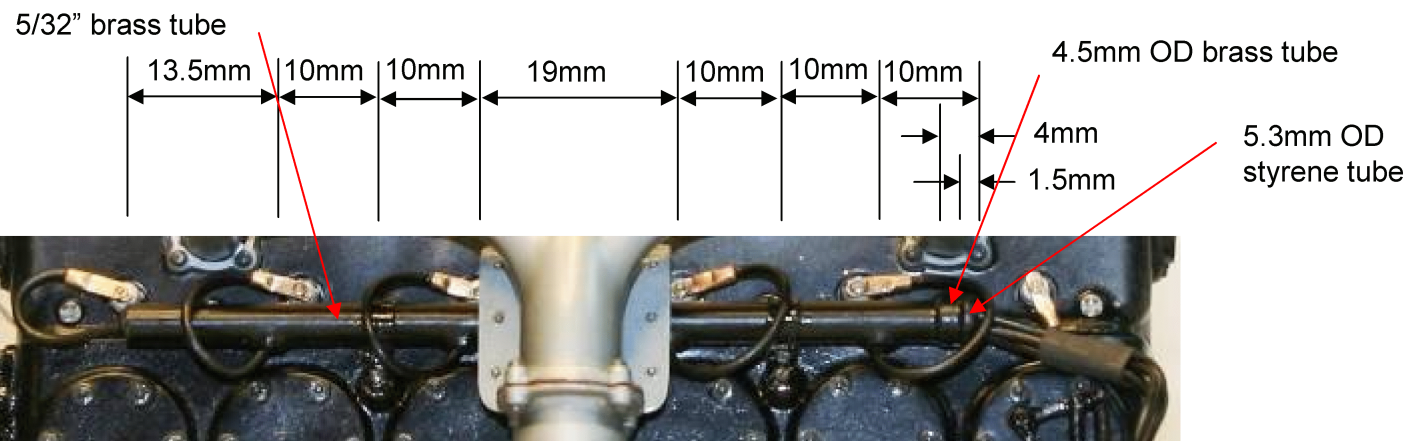
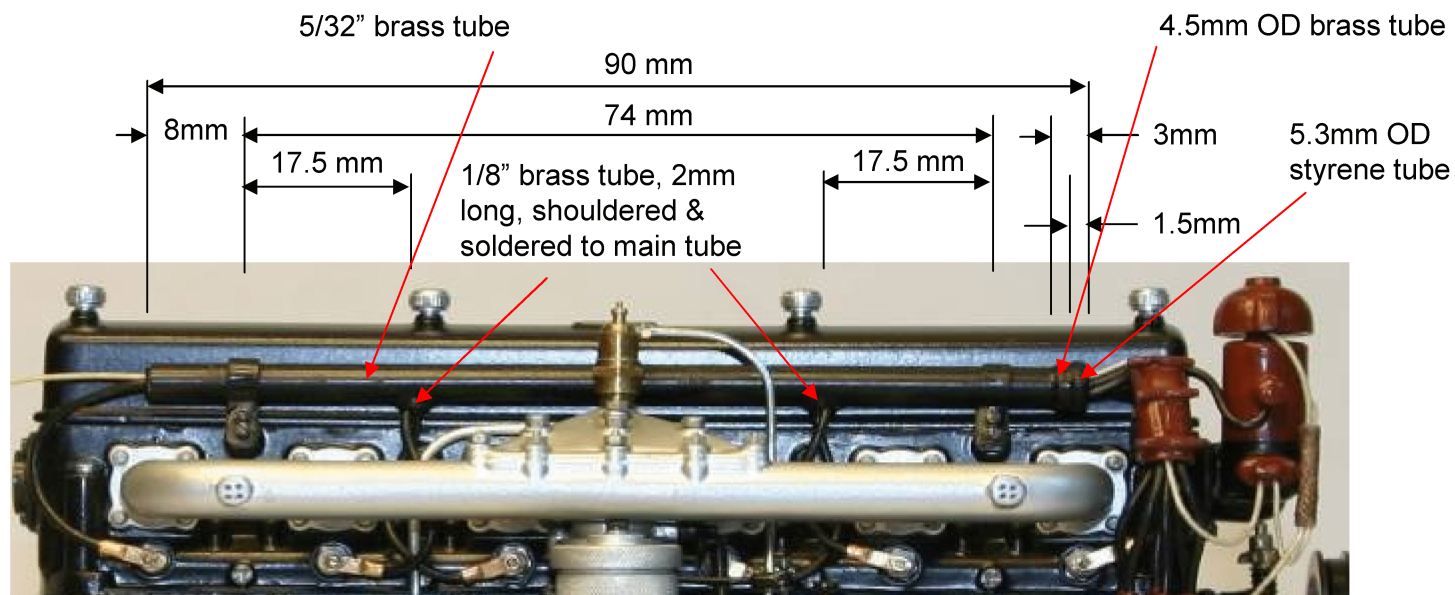
The Pocher oil filter and oil line are incorrect in a number of ways. This is a lot closer to reality!!



IGNITION WIRING & TUBES-1

Ignition wires were routed through tubes on both inlet and exhaust sides

Tube Construction and Wire Layout



IGNITION WIRING & TUBES-2

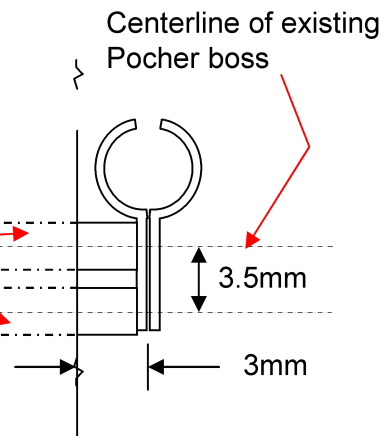
Ignition wire tubes were supported by clamshell type brackets. The ignition wire loom was attached to the cylinder head by a cantilevered bracket. A resin model of the loom is available from Model Motor Cars.

Ignition Tube Mounting Brackets

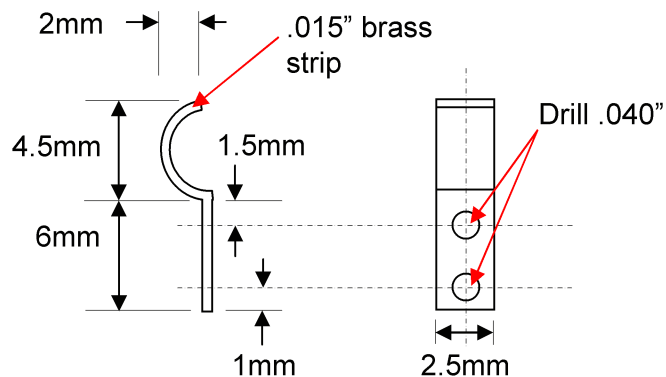
Bracket Mounting

Cut off existing bosses flush with engine wall. Drill holes for 3/32" tubes as shown below.

3/32" brass tubes.
Sleeve with 1/16" tubes.
Drill out for 1.0mm stud



Bracket Construction *



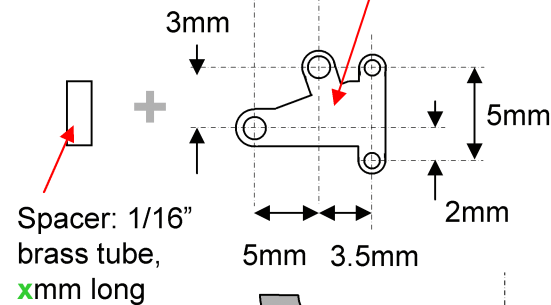
* If necessary, to provide clearance for the starting carburetor, bend the top of the inlet side brackets so that the inside edge is up against the rocker cover.

Wiring Loom Bracket

Model Motor Cars
wiring loom

1/16" brass
tubes, 2.5mm
long. Glue in
place.

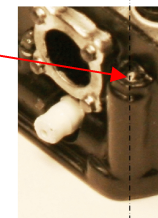
0.020" brass
sheet



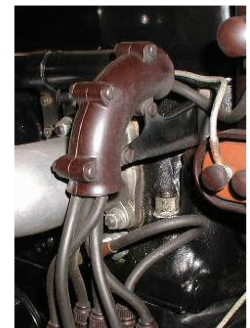
Spacer: 1/16"
brass tube,
5mm long

1/32" rod.
Add nut to top

Drill 1/32" vertical hole
for rod in this corner of
cylinder head.
Attach loom to bracket
with 1.0mm nuts & bolts.



Prototype



Model

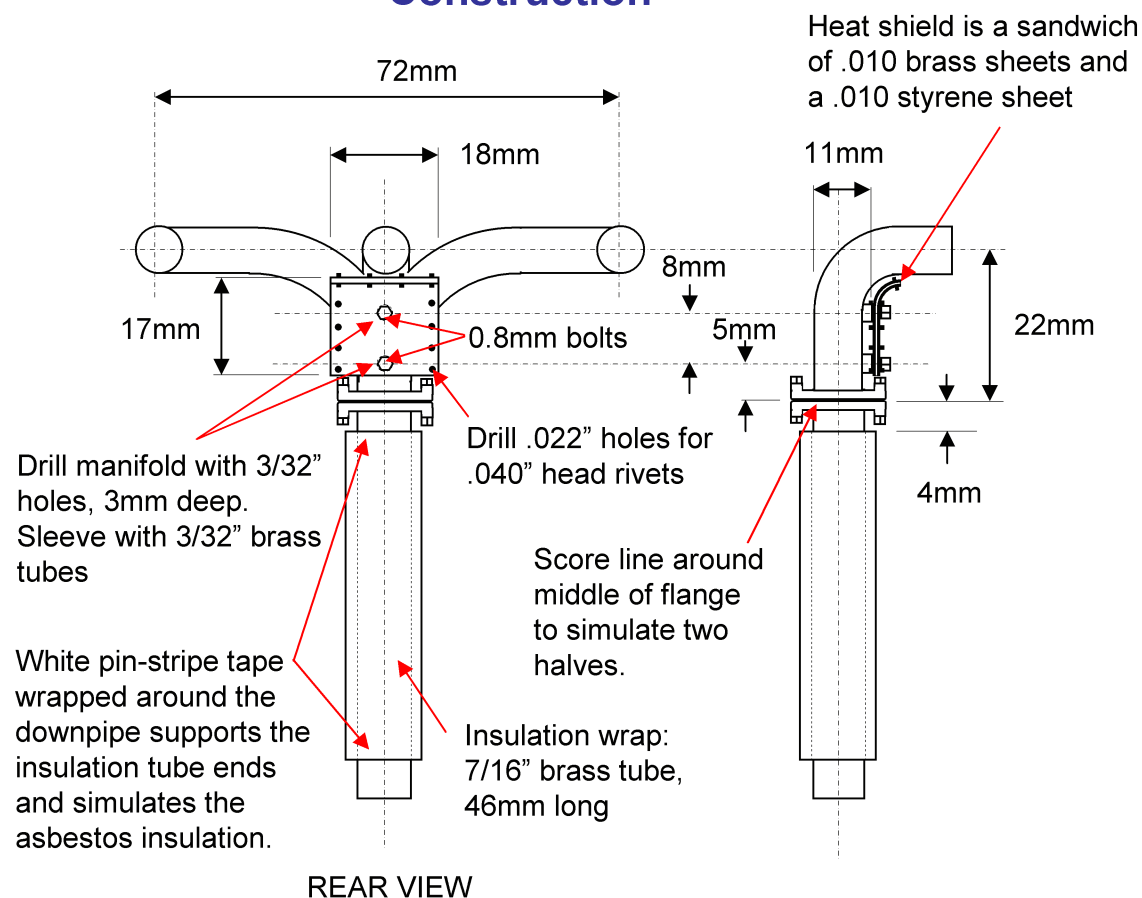


EXHAUST MANIFOLD, DOWNPIPE & HEAT SHIELD

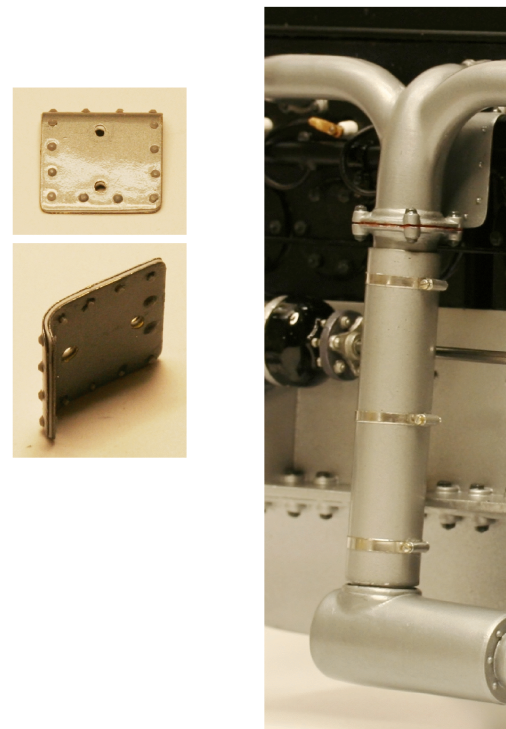
In August 1931, a heat shield was added to the exhaust manifold to reduce damage to the ignition wires running behind the manifold. The shield was a sandwich of two steel plates and an asbestos core, riveted together. A bolt-on version was made available for retrofitting to earlier engines.

The exhaust downpipe was usually wrapped with an insulating sleeve, held in place by three clamps (construction of the clamps is described on the following page).

Construction



Models

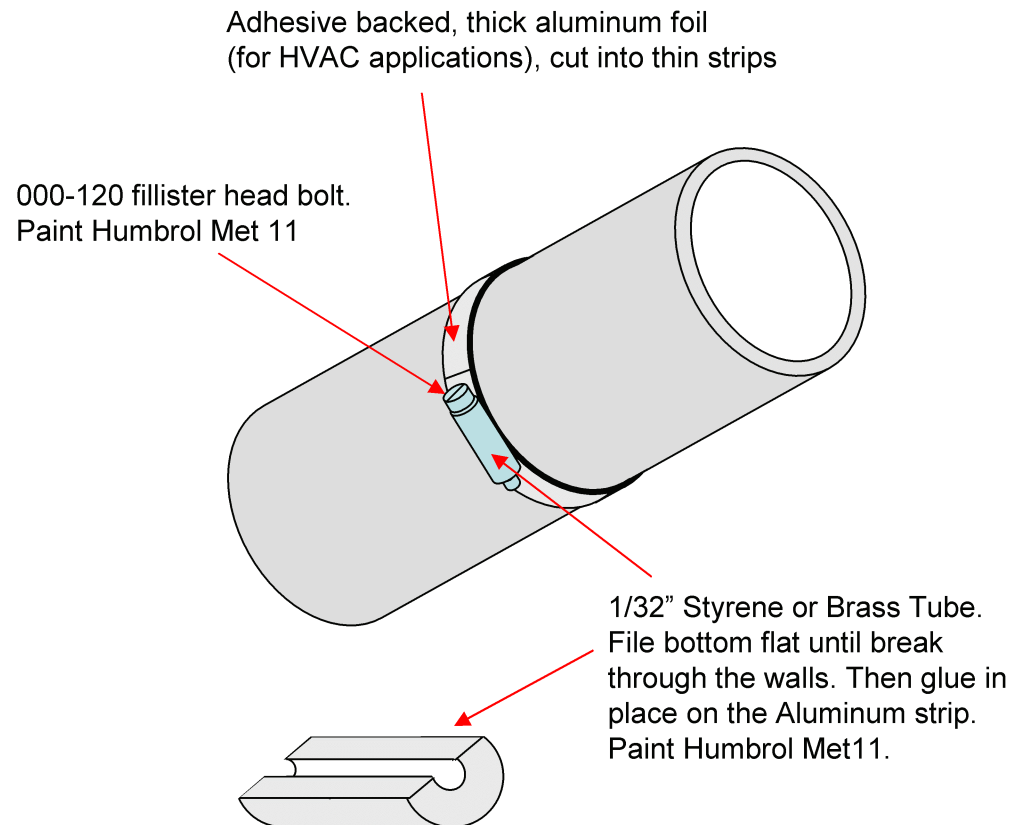


HOSE CLAMPS

(Jubilee Clips in England)

Typically, the exhaust downpipe insulating sleeve was held in place by three hose clamps. Here's a general method of making these type of hose clamps.

Making The Clamps



Chassis Model



OIL CAN HOLDER

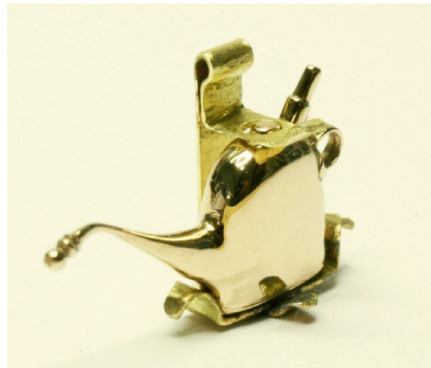
Rolls-Royce made available a small oil can for on-the-spot lubrication. Model Motor Cars offers an excellent miniature version. But how best to attach it? This page dimensions a holder for the oil can based on an actual full sized holder. The holder can be fixed in place with a countersunk bolt through either it's floor or rear wall.

Oil Can

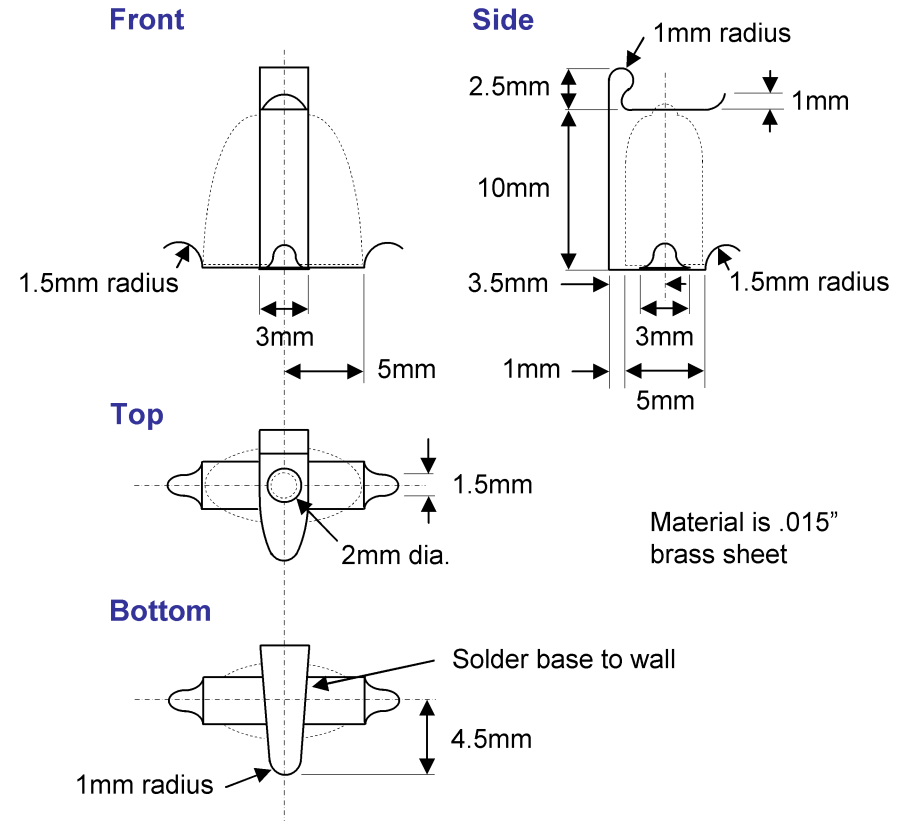
(from Model Motor Cars)



Holder Under Construction



Holder



LINKING DIMENSIONS

Scratch building requires dealing with a variety of dimensional systems; not just English and metric, but also systems for wire, drills and hardware. For reference, this table links some of the key dimensions. Each row represents a common diameter.

Dimensions				Selected Full Size	American Wire Gauge		Selected Telescopic Round Brass Tubes				Drill Sizes		Hardware (typical dimensions)				
English		Metric			Eqvlt (1/8 Scale)	Ga	ins	Normal		Thin Wall		#	ins	Size	Bolt Shaft		Hex Head
Fraction in	Decimal in	mm	Round mm	OD (.014" Wall)				ID (.006" Wall)	OD (.014" Wall)	ID (.006" Wall)	(in)				(mm)	(in)	(mm)
					28	0.014					78	0.016					
1/64	0.016	0.40	0.4	1/8	26	0.017					76	0.020					
				3/16	24	0.020					74	0.022	0.5mm	0.020	0.50	0.030	0.76
					22	0.025								0000-160	0.021	0.53	0.047
1/32	0.031	0.79	0.8	1/4	20	0.032			1/32	1/64	68	0.031	0.8mm	0.031	0.80	0.042	1.07
											66	0.033					
											64	0.036	000-120	0.034	0.86	0.078	1.98
				5/16	18	0.040					60	0.040	1.0mm	0.039	1.00	0.055	1.40
3/64	0.047	1.19	1.2	3/8	16	0.051			3/64	1/32	56	0.047	00-90	0.047	1.19	5/64	1.98
													0-80	0.060	1.52	3/32	2.38
1/16	0.063	1.59		1/2	14	0.064	1/16	1/32	1/16	3/64	52	0.063					
													1-72	0.073	1.85	7/64	2.78
5/64	0.078	1.98	2.0	5/8	12	0.081	5/64	3/64	5/64	1/16			Pocher Rod	0.079	2.00		
											46	0.081	2-56	0.084	2.13	1/8	3.18
3/32	0.094	2.38		3/4			3/32	1/16	3/32	5/64	42	0.094					
7/64	0.109	2.78		7/8	10	0.102	7/64	5/64	7/64	3/32							
1/8	0.125	3.18		1			1/8	3/32	1/8	7/64							
9/64	0.141	3.57					9/64	7/64	9/64	1/8							
5/32	0.156	3.97	4.0	11/4			5/32	1/8	5/32	9/64							
11/64	0.172	4.37					11/64	9/64	11/64	5/32							
3/16	0.188	4.76		11/2			3/16	5/32	3/16	11/64							
13/64	0.203	5.16															
7/32	0.219	5.56															
15/64	0.234	5.95	6.0														
1/4	0.250	6.35															
17/64	0.266	6.75															
9/32	0.281	7.14															
19/64	0.297	7.54															
5/16	0.313	7.94	8.0														