

64 m/m BORE x 54 m/m STROKE = 173.5 ccs.

$\frac{\text{STROKE}}{\text{BORE}} / \frac{\text{BORE}}{\text{STROKE}} \text{ RATIO} = .843$

LENGTH OF CONN-ROD = 4.250"

CONN-ROD/STROKE RATIO = 2

PRIMARY DRIVE :- ENGINE SPROCKET = 20T.

CLUTCH " = 49T.

SPROCKET CENTRES = 5.636"

LENGTH OF CHAIN = 66 PITCHES, .375" PITCH

CHAIN NO: 110 038

FINAL DRIVE SPROCKET = 17T (.500" PITCH)

PRIMARY CHAIN LINE =  $3\frac{3}{8}$ " FROM  $\phi$ . SECONDARY CHAIN LINE =  $2\frac{3}{8}$ " FROM  $\phi$ .

TIMING GEARS :- ENGINE 26T

C/BREAKER SHAFT 52T

OIL PUMP DRIVING GEAR 52T

CENTRE DISTANCES  $1.951$ "  
 $1.950$ "

20 D.P. 20° ~~DEPTH~~ <sup>FULL DEPTH</sup>

CAMSHAFT CHAIN DRIVE :- SPROCKETS 16T.

LENGTH OF CHAIN = 62 PITCHES, .375" PITCH

CENTRE DISTANCE = 8.625" MAX (HOT)

= 8.606" MAX (COLD)

VALVE DIAMETERS :- INLET =  $\frac{1}{4}$ " DIA

EXHAUST =  $\frac{1}{8}$ " DIA

VALVE ANGLE = 60° INCL.

RADIUS OF COMBUSTION SPHERE = ~~1/16~~  $\frac{1}{16}$ "  $\frac{1}{16}$ " (CENTRE OF SPHERE  $\frac{17}{32}$ "  
BELOW JOINT FACE)

HEIGHT OF PISTON ABOVE G/PIN CENTRE =  $\frac{1}{4}$ " +  $\frac{1}{4}$ " DOME

HEIGHT OF CYL BARREL ACROSS FACES =  $2.655/2.650$ " + SPIGOT HEIGHT .217" <sup>.222</sup>

CYL HEAD GASKET .046" THICK SOLID COPPER.

CYL BASE GASKET .010" THICK MANILLA "A" PAPER

COMPRESSION RATIO APPROX 9.5:1

HEIGHT OF CAMSHAFT HOUSING FROM FACE TO  $\phi$  OF CAMSHAFT =  $1.025$ " <sup>1.030"</sup>

Pin Acceleration of 100,000 ft/sec<sup>2</sup> = 9,080 R.P.M.

Prototype Weights

Conn Rod Small End & Bush ~~9oz 12drms~~ <sup>4oz</sup>

Conn Rod Big End, Cap, Liners & Screws 9oz 12drms

Piston, rings, circlips & C/Pin 9oz 7drms

Reciprocating Weight  $4 + 9oz 7 = 13oz 7drms$

Rotating Weight = 9oz 12drms

75% Balance = 9oz 12 + ( $\frac{3}{4} \times 13oz 7$ )

= 9oz 12 + 10oz 1 = 19oz 13drms.

Balance weight  $3\frac{1}{4}$  o/p  $1\frac{9}{16}$  Bore  $\times \frac{3}{4}$ ,  $\frac{1}{16}$  wide sawcut  
no 2 - 175 Big end bolts

AMAL CARBURETTOR 375/  
EXHAUST PIPE

25/32" DIA. CHOKE

1 1/4" O/DIA x 19 SW.G. (.040")

### ESTIMATED WEIGHTS

CONN ROD W. 47296	{ BIG END	3.069 oz
	{ SMALL END	3.184 oz
CONN ROD CAP W. 47297		2.944 oz
SMALL END BUSH W. 47299 (ALUM ALLOY)		.221 oz
BIG END SMALL W. 47298		1.254 oz per pair
BIG END CAP SCREW W. 47300, .654 x 2 =		1.308 oz per set
" " " " WASHER .007 x 2 =		.014 oz " "
		7.218 oz
Piston including rings & circlips		<del>7.575 oz</del>
Gudgeon Pin		1.738 oz.

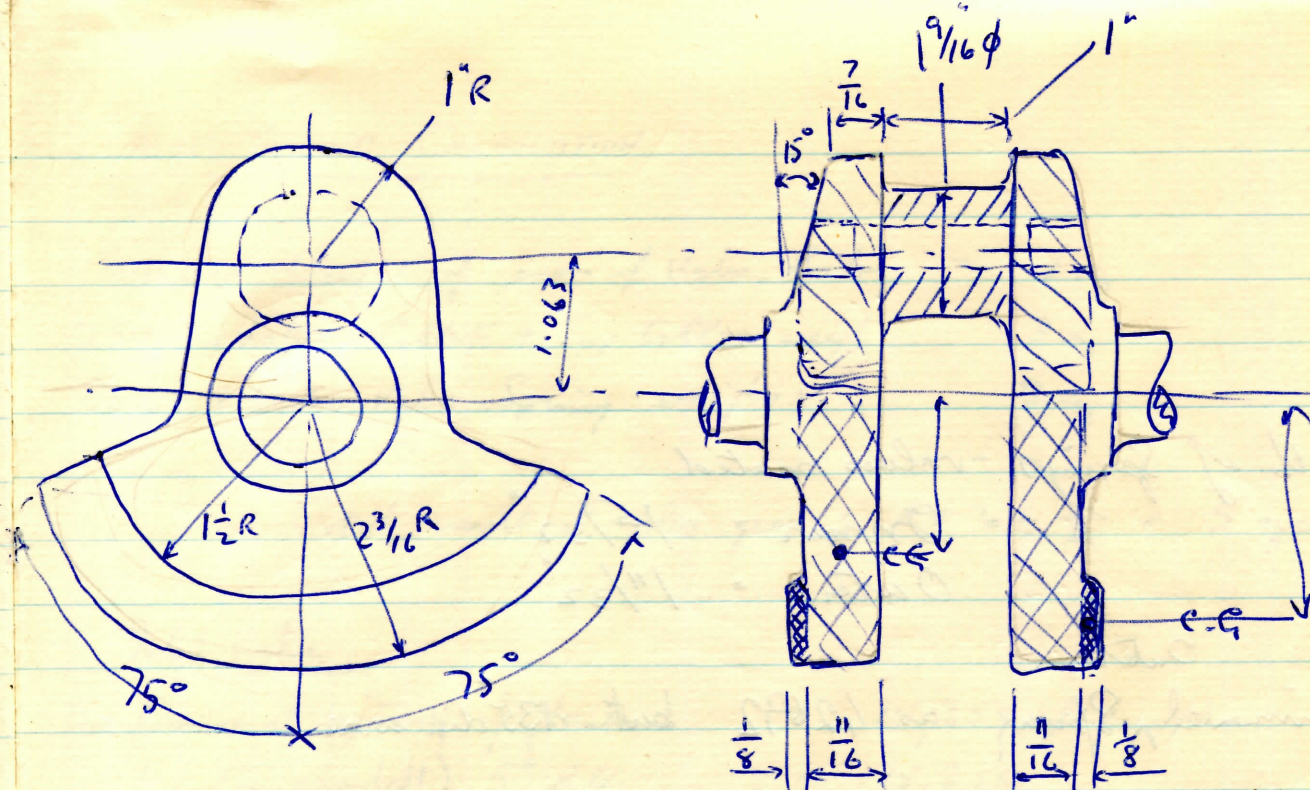
$$\begin{aligned} \text{Reciprocating Weight} &= 3.184 + .221 + 7.218 + 1.738 \\ &= 12.361 \text{ oz.} \end{aligned}$$

$$\begin{aligned} \text{Rotating Weight} &= 3.069 + 2.944 + 1.254 + 1.308 + .014 \\ &= 8.589 \text{ oz.} \end{aligned}$$

∴ Weight to be added to crankpin to give

$$\begin{aligned} \text{balance factor of 75\%} &= 8.589 + \left(\frac{3}{4} \times 12.361\right) \\ &= 8.589 + 9.271 = 17.86 \text{ oz.} \end{aligned}$$

Total Weight of Engine = 92 lb. (including carb)



Weight of Big End Journal  $1 \frac{9}{16} \phi \times 1''$  with  $\frac{1}{4} \phi$  hole = 8.064 ozs

Weight of Big End Flanges  $2'' \phi \times 1 \frac{1}{8}''$  average width = 15.264 ozs

Weight to be added to give 75% balance factor = 17.860 ozs

Total weight at 1.063" from centre = 41.188 ozs


= 43.661 in/ozs to be balanced by bobweights

C.G. of Sector marked  = 1.076" from centre

Area - - - - = 6.268 sq ins

~~Volume~~ Weight - - - - = 2.345 lbs = 37.55 ozs

Moment =  $37.55 \times 1.076 = \underline{40.404}$  in/ozs

C.G. of Ring Sector marked  = 1.378" from centre

Area - - - - = 3.32 sq ins

~~Volume~~ Weight - - - - = .224 lbs = 3.584 ozs

Moment =  $3.584 \times 1.378 = \underline{4.940}$  in/ozs

Total Moment of balance weights = 45.344 in/ozs

Length of Springs - values selected

= Inner =  $1\frac{5}{32}$ "

Outer =  $1\frac{11}{32}$ "

Outer  
Experimental Spring as 42692 but .135" die wire

20% max load

Experimental Inner Spring as 42693 but .110" die wire.

# VALVE SPRING CALCULATION

9-5-62

Estimated Weight of ends of Valve Rocker = 1 oz  
250 Sx Valve + Collets + Top Collar weigh 3 oz  
Inner + Outer Valve Springs weigh 2 oz

$$\text{Total weight of valve gear} = 1 + 3 + \frac{2}{2} = 5 \text{ oz} = 312 \text{ lb}$$

## Inlet Valve

Acceleration at beginning of flank = 15,850 ft/sec/sec  
(on camshaft) 5° later = 15,850  
10° = 16,100  
15° = 16,400  
20° = 17,300  
25° = 18,000  
30° = 18,900  
34° = 19,950

15000 R.P.M.

## Deceleration round nose

(on camshaft) 33½° before apex = 13,400 ft/sec/sec  
30° = 14,480  
25° = 15,600  
20° = 16,700  
15° = 17,600  
10° = 18,400  
5° = 18,600  
0° = 18,750

10,000 R.P.M.

$$F = \frac{A \times W \text{ lbs}}{32.2} = \frac{18,750 \times 312}{32.2} = 184 \text{ lbs max. acceleration force}$$

(see graph)  $\rightarrow \frac{20,500 \times 312}{32.2} = 198.5 \text{ lbs max force on spring.}$

$\rightarrow 9,500 \times 312$

For

Re

Length of Springs - values selected  
= Inner =  $1\frac{5}{32}$ "  
Outer =  $1\frac{11}{32}$ "

N

S

S

Experimental <sup>Outer</sup> Spring as 42692 but .135" die wire

Tu

→ 20% max load

Tu

Experimental Inner Spring as 42693 but .110" die wire

Tu

Br

Hot

Engin

Batts

lay

Core

Ind

# VALVE SPRING CALCULATION

9-5-62

Estimated Weight of ends of Valve Rocker = 1 oz  
250 Sx Valve + Collets + Top Collar weigh 3 oz  
Inner + Outer Valve Spring weights 2 oz

$$\text{Total weight of valve gear} = 1 + 3 + \frac{2}{2} = 5 \text{ oz} = 3.12 \text{ lbs}$$

## Inlet Valve

Acceleration at beginning of flank = 15,850 ft/sec/sec  
(on camshaft) 5° later = 15,850  
10° - = 16,100  
15° - = 16,400  
20° - = 17,300  
25° - = 18,000  
30° - = 18,900  
34° - = 19,950

10,000 R.P.M.

## Deceleration round nose

(on camshaft) 33½° before apex = 13,400 ft/sec/sec  
30° - - - = 14,480  
25° - - - = 15,600  
20° - - - = 16,700  
15° - - - = 17,600  
10° - - - = 18,400  
5° - - - = 18,600  
0° - - - = 18,750

10,000 R.P.M.

$$F = \frac{A \times W \text{ lbs}}{32.2} = \frac{18,750 \times 3.12}{32.2} = 184 \text{ lbs max. acceleration force}$$

(see graph)  $\rightarrow \frac{20,500 \times 3.12}{32.2} = 198.5 \text{ lbs max force on spring.}$

# GEAR PUMP CALCULATIONS

11-5-62

USE Standard cutters to B.S. 436,  $20^\circ$  pressure angle,  
involute form, full depth, 20 D.P.

Driving gear has been corrected  $+0.0086$ ; Driven gear  $-0.0086$

$$\text{Centre distance} = \frac{\text{No of teeth} + 1}{D.P.}$$

This form prevents oil trapping at root of teeth where mating.

$$\text{No of TEETH} = 13$$

$$\text{DIAMETRAL PITCH} = 20$$

$$\text{CENTRE DISTANCE} = .700''$$

$$\text{WORKING PRESSURE ANGLE} = 29^\circ 15'$$

$$\text{DRIVER} \left\{ \begin{array}{l} \text{ADDENDUM} = .0586'' \\ \text{DEDENDUM} = .0516'' \\ \text{O/DIA} = .8172'' \\ \text{PITCH DIA} = .700'' \\ \text{ROOT DIA} = .5968'' \end{array} \right. \left( .5874'' \text{ FOR FELLOWS CUTTER} \right)$$

$$\text{DRIVEN} \left\{ \begin{array}{l} \text{ADDENDUM} = .0414'' \\ \text{DEDENDUM} = .0688'' \\ \text{O/DIA} = .7828'' \\ \text{PITCH DIA} = .700'' \\ \text{ROOT DIA} = .5624'' \end{array} \right. \left( .553'' \text{ FOR FELLOWS CUTTER} \right)$$

$$\text{WORKING DEPTH} = .100''$$

$$\text{BOTTOM CLEARANCE} = .0102''$$

$$\text{FULL DEPTH FOR CUTTING} = .1102''$$

$$\text{BACKLASH} = .005''$$

$$\text{WIDTH OF GEARS} = \frac{1}{4}'' \cdot .2500'' = .2495''$$

$$\text{NOMINAL DISCHARGE AT } 1000 \text{ R.P.M OF PUMP} = .199 \text{ gal/min}$$

21-6-62

TIRE SIZES

DESIGN FOR THE FOLLOWING:-

2.50" x 17" RIBBED, LIGHTWEIGHT REINFORCED, FRONT  
ON W.M. 1-17 RIM

3.00" x 17" STUDDED, LIGHTWEIGHT REINFORCED, REAR  
ON W.M. 2-17 RIM.

THE FOLLOWING TO BE FITTED ON PROTOTYPE MACHINES:-

3.00" x 16" STUDDED UNIVERSAL, FRONT  
ON W.M. 2-16 RIM

3.25" x 16" STUDDED, LIGHTWEIGHT REINFORCED, REAR  
ON W.M. 2-16 RIM.

GEAR RATIOS

ENGINE SPROCKET	20T	} 7.06 TOP GEAR
CLUTCH	49T	
FINAL DRIVE	17T	
REAR	49T	

GEAR-BOX RATIOS

FINAL RATIOS

TOP	<del>1.25</del>	1	7.06
4TH	<del>8.83</del>	1.25	8.83
3RD	<del>4.23</del>	1.59	11.23
2ND	<del>15.20</del>	2.13	15.04
1ST	<del>20.40</del>	2.89	20.40

M.P.H. / 1000 R.P.M IN TOP GEAR

PROTOTYPE WITH 3.25 x 16" = ~~10.00~~ 9.37 MPH / 1000 REVS. P.M.

PRODUCTION WITH 3.00 x 17" = 9.52 (estimated without tables)

DESIGN FOR THE FOLLOWING:-

2.50" x 17" RIBBED, LIGHTWEIGHT REINFORCED, FRONT  
ON W.M. 1-17 RIM

3.00" x 17" STUDDED, LIGHTWEIGHT REINFORCED, REAR  
ON W.M. 2-17 RIM.

THE FOLLOWING TO BE FITTED ON PROTOTYPE MACHINE:-

3.00" x 16" STUDDED UNIVERSAL, FRONT  
ON WM 2-16 RIM

3.25" x 16" STUDDED, LIGHTWEIGHT REINFORCED, REAR  
ON WM 2-16 RIM.

### GEAR RATIOS

ENGINE SPROCKET	20T	} 7.06 TOP GEAR
CLUTCH	49T	
FINAL DRIVE	17T	
REAR	49T	

<u>GEAR-BOX</u>	<u>RATIOS</u>	<u>FINAL RATIOS</u>
TOP	<del>1.0</del> 1	7.06
4TH	<del>1.25</del> 1.25	8.83
3RD	<del>1.59</del> 1.59	11.23
2ND	<del>2.13</del> 2.13	15.04
1ST	<del>2.89</del> 2.89	20.40

### M.P.H. / 1000 R.P.M IN TOP GEAR

PROTOTYPE WITH 3.25 x 16" = ~~9.37~~ 9.37 MPH / 1000 REVS. P.M.

PRODUCTION WITH 3.00 x 17" = 9.52 (estimated without tables)

9,080 R.P.M. (Engine at 100,000 ft/sec<sup>2</sup> piston ~~speed~~ <sup>acceleration</sup>) = 85 mph (Prototype)  
86.4 " (Production)

Ignition Advance =  $40^\circ$  BTDC (advanced)

Clamping adjustment to both chains.

Hold down Clutch end of Primary Tensioner?

Rubber clogging filter.

Ex Valve close to piston, touched when timing is advanced  $5^\circ$

Value Lockers Change material and finish follower per stellite or spray

3/4/65

Rev Counter Drive to be 2/1 Box, 32" long cable

Anticlock looking at Engine O.S.

Box to be reversing. Rev Counter Head to be 4:1, Clockwise, 60mm Dia  
Calibrated to 10,000

Smiths would supply their gears for us to build into Timing Cover.

Speedo & Rev Counter Heads / holes & Fork Head will need to be smaller

Value Springs Outer - W47931, Inner W.47932

Nylon Primary Chain Tensioners.

Altered OHV Tensioners.

1st OCTOBER 1962

## Assembly of 1st Prototype Engine

Difficulty in balancing 75% of reciprocating weight.  
Bob-weights plugged with lead.

Increase % of Bobweights

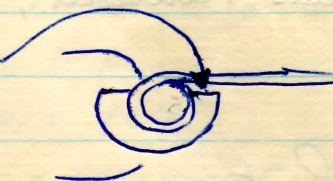
Reverse stop / cyl head pins around ex. port.

T/Side Crankcase, Main Bearing Box too big, fouls inside bobweight.

D/Side Crankcase, Flywheel Scraper fouls Flywheel.

Timing Gear Spacer; Bottom of recess fouls large rod on crankshaft

Timing Pointer fouls casting, square hole not to drawing.

Primary Chain tensioner fouls casting 

Gear Change Cover - cut away wall to clear contact breaker wire

Timing Chain Damper. 47425 (10399u)

Neoprene is  $\frac{3}{16}$ " thick, should be  $\frac{1}{8}$ "

C breaker plate cannot be removed without first pulling out coil wire. This necessitates the removal of the Foot change cover.

Hole in Primary Chaincase to feel tension of chain.

27-10-62 Pistons with .070" higher crown ordered.

Portion of Horn & Inletor

Increase o/d of Bobweights

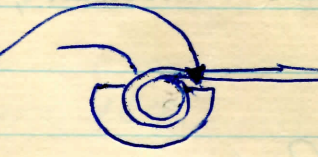
Increase size of cyl head pins around ex. part.

T/Side Crankcase, Main Bearing Boss too big, fouls inside bobweight.

D/Side Crankcase, Flywheel Scraper fouls Flywheel.

Timing Gear Spacer; Bottom of recess fouls large rod on crankshaft

Timing Pointer fouls casting, square hole not to drawing.

Primary Chain tensioner fouls casting 

Foot Gear Change Cover - cut away wall to clear contact breaker wire.

Timing Chain Damper. 47425 (10399w)

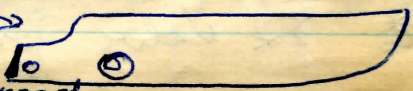
Neoprene is  $\frac{3}{16}$ " thick, should be  $\frac{1}{8}$ "

C breaker plate cannot be removed without first pulling out coil wire. This necessitates the removal of the Foot change cover.

Hole in Primary Chaincase to feel tension of chain.

27-10-12 Pistons with .070" higher crown ordered.

Portion of Horn & Inletor

Cutaway Top Side Panels and delete one hole each side in in/guard 

# 175 O.H.C.

19<sup>th</sup> DEC. 62.

CAMSHAFT. LOWERED  $\frac{3}{8}$ "; VALVES LENGTHENED  $\frac{3}{16}$ " (<sup>EXTRA IS ONLY</sup> ABOVE COLLET);  
ROCKER CR'S MOVED OUT PARALLEL WITH VALVE CR'S BY  $\frac{3}{16}$ ";  
NEW CAMSHAFT HOUSING DRAWN; CYL HD. BOSSES FOR  
MTG. OF HOUSING. REDUCED IN HEIGHT BY  $\frac{3}{8}$ "; CHAIN (O.H.C.)  
SHORTENED BY ONE LINK ( $\frac{3}{8}$ "); ROCKER COVER BOSSES  
MATING WITH BOSSES (ON 1.9375" CR'S) ON CAMSHAFT HOUSING ARE  
MACHINED TO A GREATER DEPTH I.E. INSTEAD OF  $1\frac{19}{32}$ "  
VALVE SPRINGS ~~THE~~ <sup>SAME.</sup> ~~LENGTH~~; ROCKER ARMS. NEW DRG, ARMS  
ARE NOW EQUAL AT  $\frac{1}{8}$ " EACH SIDE OF ROCKER ARM CENTRE; RADIUS  
AT CAM END OF ARM INCREASED FROM \_\_\_\_\_ TO \_\_\_\_\_ ;  
NEW CAMSHAFT. NEW CAM PROFILE AND BASE CIRCLE.