Green Diamond Engine Excerpts

"K" AND "KB" LINE TRUCK SERVICE MANUAL CTS-8

MOTOR TRUCK DIVISION
INTERNATIONAL HARVESTER COMPANY
180 NORTH MICHIGAN AVE. CHICAGO 1, ILLINOIS, U.S.A.

PRINTED IN UNITED STATES OF AMERICA

Engine Specifications

The following list shows K-line trucks and their corresponding Engine Models. Specifications of the individual Engine Models will be found on Specification Pages 2 to 9.

TRUCK MODEL	** ENGINE MODEL
* K-1	GRD-214
* K-1M	GRD-214-A
* K-2	GRD-214
* K-3	GRD-214
* K-3M	GRD-214-A
* K-4	GRD-214
* KS-4	GRD-214
* K-5	GRD-233
* KS-5	GRD-233
K-5B	GRD-233
K-5-COE	GRD-233-A
KS-5-COE	GRD-233-A
K-6	FAC-241 or BLD-250
KS-6	FAC-241 or BLD-250
K-6B	FAC-241 or BLD-250
K-6T	FAC-241 or BLD-250
KS-6T	FAC-241 or BLD-250
K-6F	FAC-241 or BLD-250
K-7	FAC-259 or BLD-269
KS-7	FAC-259 or BLD-269
K-7-COE	FAC-259-A or BLD-269-A
KS-7-COE	FAC-259-A or BLD-269-A

TRUCK MODEL	*** ENGINE MODEL
K-8	FBC or RED-318, RED-361
KR-8	FBC or RED-318, RED-361
KS-8	FBC or RED-318, RED-361
K-8-COE	FBC or RED-318-A
KR-8-COE	FBC or RED-318-A
KS-8-COE	FBC or RED-318-A
K-8T	FBC or RED-318
KR-8T	FBC or RED-318
KS-8T	FBC or RED-318
K-8F	FBC or RED-318, RED-361
K-8T-COE	FBC or RED-318-A
K-8F-COE	FBC or RED-318-A
K-10	FBC or RED-361, RED-401
KR-10	FBC or RED-361, RED-401
KS-10	FBC or RED-361, RED-401
KR-11	FBC or RED-401, RED-450
KS-11	FBC or RED-401, RED-450
KR-11-COE	FBC or RED-401-A
KS-11-COE	FBC or RED-401-A
KR-11T	FBC or RED-401
KR-11T-COE	FBC or RED-401-A
K-11F-COE	FBC or RED-401-A
K-11F	FBC or RED-401, RED-450
KR-12F	FBC or RED-450-A
KR-12	R-6586
KS-12	R-6586
KBR-14	R-6586
KBS-14	R-6586

* Indicates GRD-175 Engine was Available.

NOTE: Engine models bearing suffix letter "A" (FAC-259-A) indicate updraft carburetion.

**** BLD-250 and BLD-269 engines started in production as follows:**

Model	Chassis Serial Number
K-6	11242
KS-6	7126
K-7	9100
KS-7	3036
K-7-COE	1419
KS-7-COE	820
K-6T	547
K-6F	597

***** RED Engines started in production as follows:**

Model	Chassis Serial Number
K-8	3234
KS-8	1875
KR-8	2073
K-8T	511
K-8F	873
K-8-COE	640
KS-8-COE	540
KR-8-COE	612
K-8F-COE	525
K-8T-COE	501
K-10	641
KS-10	618
KR-10	1538
KR-11	1656
K-11F	604
KR-11T	504
KR-11T-COE	660
K-11F-COE	525

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Engine Specifications

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	(*) FAC-241 FAC-241A	(**) (***) FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Number of Cylinders	6	6	6	6	6	6	6	6	6	6	6
Bore	3″	3 5/16″	3 5/16″	3 3/8″	3 1/2″	3 7/16″	3 9/16″	3 7/8″	4 1/8″	4 1/8″	4 3/8″
Stroke	4 1/8″	4 1/8″	4 1/2″	4 1/2″	4 1/2″	4 1/2″	4 1/2″	4 1/2″	4 1/2″	5″	5″
Displacement (cu. in.)	174.93	213.24	232.65	241.54	259.76	250.56	269.10	318.41	360.82	400.92	450.99
Rated H.P. (A.M.A.)	21 6	26.3	26.3	27.3	29.4	28.3	30.4	36.03	40.8	40.8	45.9
Brake H.P. (Maximum)	63.7	82.4	93	84 (94.9)	89.1 (101.0)	99.8	100.5	100.0	111.4	114.2	120
At R.P.M.	3400	3400	3400	3200	3200 (3000)	3200	3000	2800	2700	2600	2400
Brake H.P. (Net)	58.2	73.0	80.2	74.1 (84.0)	76.4 (87.8)	84.0	88.6	85.0	93.7	99	104.0
At R.P.M.	3400	3200	3400	3000 (3200)	3000 (2800)	3000	2800	2600	2600	2400	2300
Torque—Maximum (lb.-ft.)	120	160	181	175.5(192.0)	192 (211.0)	200.5	222.0	241	268	308	331
At R.P.M.	1000	1200	1000	800 (1200)	800 (1600)	2000	1000	800	1500	800	800
Torque—Net (lb.-ft.)	117.5	158	176.5	171	186	194	216.5	229	260	298	320
At R.P.M.	800	1000	800	800	800	800	1000	800	1000	700	800
Maximum Recommended Speed, R.P.M.	3400	3400	3400	3000	3000	3000	3000	.....	.....	.....	.....
Governed Speed, R.P.M.	.....	.....	.....	.....	.....	.....	.....	2700	2600	2500	2400
Compression Ratio	6.7	6.3	6.3	5.8 (6.2)	5.74 (6.2)	6.3	6.3	5.38	5.2	5.2	5.2

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Number of Cylinders	6	6	6	6	6
Bore	3 7/8″	4 1/8″	4 1/8″	4 3/8″	4 13/16″
Stroke	4 1/2″	4 1/2″	5″	5″	5 3/8″
Displacement (cu. in.)	318.41	360.82	400.92	450.99	586.62
Rated H.P. (A.M.A.)	36.03	40.8	40.8	45.9	55.5
Brake H.P. (Maximum)	124.5	126.0	140	148.3	200.3
At R.P.M.	3100	2800	2800	2600	2600
Brake H.P. (Net)	111	111.9	123	133.5	183.0
At R.P.M.	2800	2800	2800	2600	2600
Torque—Maximum (lb.-ft.)	250	282	304	361.5	475.0
At R.P.M.	1600	1200	1000–1500	1000	1000
Torque—Net (lb.-ft.)	248	278	304	348	462.0
At R.P.M.	1200	1000	1000	1000	1000
Maximum Recommended Speed, R.P.M.	.....	.....	.....	.....	.....
Governed Speed, R.P.M.	3000	2800	2700	2600	2600
Compression Ratio	6.3	6.3	6.3	6.3	6.03

* Figures in brackets apply to FAC-241 Engine Serial Number 2401 and above.
** " " " " " " FAC-259 " " " 3301 " "
*** " " " " " " FAC-259A " " " 751 " "

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	(*) FAC-241 FAC-241A	(**) (***) FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Crankcase Refill Capacity (qts.)	5	5	5	7	7	7	7	7	7	7	7
Weight—Bare (lbs.)	527.5	528.5	559.5	755.1	750.1	782	781	930	913	961	950
Weight—with Standard Accessories	592	593	624	848	843	875	874	1035	1018	1066	1055
Crankshaft:											
Main Journal Diameter	2.635″— 2.636″	2.635″— 2.636″	2.635″— 2.636″	2.372″— 2.373″	2.372″— 2.373″	2.7005″— 2.7015″	2.7005″— 2.7015″	2.7005″— 2.7015″	2.7005″— 2.7015″	2.7005″— 2.7015″	2.7005″— 2.7015″
Crankpin Diameter	2.000″— 2.001″	2.000″— 2.001″	2.000″— 2.001″	2.122″— 2.123″	2.122″— 2.123″	2.122″— 2.123″	2.122″— 2.123″	2.247″— 2.248″	2.247″— 2.248″	2.247″— 2.248″	2.247″— 2.248″
Bearing Clearances	.001″— .0035″	.001″— .0035″	.001″— .0035″	.001″— .0035″	.001″— .0035″	.0015″— .004″	.0015″— .004″	.0015″— .004″	.0015″— .004″	.0015″— .004″	.0025″— .005″
Crankshaft End Play	.002″— .006″	.002″— .006″	.002″— .006″	.0035″— .0075″	.0035″— .0075″	.0055″— .0135″	.0055″— .0135″	.0045″— .0085″	.0045″— .0085″	.0045″— .0085″	.0045″— .0085″
Thrust Taken By	Front Brg.	Front Brg.	Front Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.
Hardening Method	.....	.....	.....	.....	.....	.....	.....	Tocco	Tocco	Tocco	Tocco
Main Bearing Bolt Tension (ft. lbs.)	105	105	105	105	105	105	105	105	105	105	105

Engine Specifications

ENGINE MODELS	(t) RED-318 RED-318-A	(t) RED-361 RED-361-A	(t) RED-401 RED-401-A	(t) RED-450 RED-450-A	R-6586
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Crankcase Refill Capacity (qts.)	9	9	9	9	16
Weight—Bare (lbs.)	930	913	961	950	1525
Weight—with Standard Accessories	1035	1018	1066	1055	1725
Crankshaft:					
Main Journal Diameter	3.2495″— 3.2505″	3.2495″— 3.2505″	3.2495″— 3.2505″	3.2495″— 3.2505″	3.249″— 3.250″
Crankpin Diameter	2.751″— 2.752″	2.751″— 2.752″	2.751″— 2.752″	2.751″— 2.752″	2.999″— 3.000″
Bearing Clearances	.002″— .0045″	.002″— .0045″	.002″— .0045″	.002″— .0045″	.0022″— .0046″
Crankshaft End Play	.004″— .012″	.004″— .012″	.004″— .012″	.004″— .012″	.006″— .008″
Thrust Taken By	Rear Brg.	Rear Brg.	Rear Brg.	Rear Brg.	Front Brg.
Hardening Method	Tocco	Tocco	Tocco	Tocco	Tocco
Main Bearing Bolt Tension (ft. lbs.)	105	105	105	105	110

*Figures in brackets apply to FAC-241 Engine Serial Number 2401 and above.
**Figures in brackets apply to FAC-259 Engine Serial Number 3301 and above.
***Figures in brackets apply to FAC-259-A Engine Serial Number 751 and above.

(t) Oil pan refill capacities for earlier RED engines are given in Service Bulletin Add No. 1 to B-41-1945.

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	FAC-241 FAC-241A	FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Camshaft:											
Camshaft Bearing Diameter:											
Front	2.1855"— 2.1865"	2.1855"— 2.1860"	2.1855"— 2.1860"	1.811"— 1.812"	1.811"— 1.812"	1.811"— 1.812"	1.811"— 1.812"	2.109"— 2.110"	2.109"— 2.110"	2.109"— 2.110"	2.109"— 2.110"
Second	1.9335"— 1.9345"	1.9335"— 1.9345"	1.9335"— 1.9345"	1.577"— 1.578"	1.577"— 1.578"	1.577"— 1.578"	1.577"— 1.578"	2.089"— 2.090"	2.089"— 2.090"	2.089"— 2.090"	2.089"— 2.090"
Third	1.9135"— 1.9145"	1.9135"— 1.9140"	1.9135"— 1.9140"	1.562"— 1.563"	1.562"— 1.563"	1.562"— 1.563"	1.562"— 1.563"	2.069"— 2.070"	2.069"— 2.070"	2.069"— 2.070"	2.069"— 2.070"
Rear	1.6225"— 1.6235"	1.6220"— 1.6225"	1.6220"— 1.6225"	1.499"— 1.500"	1.499"— 1.500"	1.499"— 1.500"	1.499"— 1.500"	1.4995"— 1.5005"	1.4995"— 1.5005"	1.4995"— 1.5005"	1.4995"— 1.5005"
Camshaft Bearing Clearance	.0015"— .0035"	.0015"— .0035"	.0015"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"
Camshaft End Play	Spring Loaded	Spring Loaded	Spring Loaded	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"
Thrust Taken By	Thrust Plate	Thrust Plate	Thrust Plate	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange
Camshaft Gear Backlash	Timing Chain	Timing Chain	Timing Chain	.0000"— .002"	.0000"— .002"	.0000"— .0020"	.0000"— .0020"	.004"— .006"	.004"— .006"	.004"— .006"	.004"— .006"

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Camshaft:					
Camshaft Bearing Diameter:					
Front	2.109"— 2.110"	2.109"— 2.110"	2.109"— 2.110"	2.109"— 2.110"	2.1220"— 2.1225"
Second	2.089"— 2.090"	2.089"— 2.090"	2.089"— 2.090"	2.089"— 2.090"	2.1220"— 2.1225"
Third	2.069"— 2.070"	2.069"— 2.070"	2.069"— 2.070"	2.069"— 2.070"	2.1220"— 2.1225"
Rear	1.4995"— 1.5005"	1.4995"— 1.5005"	1.4995"— 1.5005"	1.4995"— 1.5005"	2.1220"— 2.1225"
Camshaft Bearing Clearance	.001"— .0035"	.001"— .0035"	.001"— .0035"	.001"— .0035"	.0015"— .0025"
Camshaft End Play	.002"— .008"	.002"— .008"	.002"— .008"	.002"— .008"	.005"— .007"
Thrust Taken By	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Flange	Thrust Plate
Camshaft Gear Backlash	.004"—.006"	.004"—.006"	.004"— .006"	.004"—.006"	.001"

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	FAC-241 FAC-241A	FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Connecting Rods:											
Connecting-Rod Bearing End Clearance	.0045"—.0105"	.0045"—.0105"	.0045"—.0105"	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"
Connecting-Rod Bearing Clearance	.0010"—.003"	.0010"—.003"	.0010"—.003"	.001"—.003"	.001"—.003"	.001"—.003"	.001"—.003"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"
Connecting-Rod Bolt Nut Tension (lb.-ft.)	80	80	80	80	80	80	80	80	80	80	80
Pistons:											
Material	C. I.	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum
Recommended Piston Clearance	.003"										
Clearance Bottom of Skirt Minimum								.00225"	.00125"	.00125"	00125"
Clearance Bottom of Skirt Maximum								.00325"	.00175"	.00175"	.00175"
Clearance Top of Skirt Minimum		.0015"	.0015"	.0025"	.0025"	.0025"	.0025"	.00425"	.00325"	.00325"	.00325"
Clearance Top of Skirt Maximum		.0025"	.0025"	.003"	.003"	.003"	.003"	.00435"	.00375"	.00375"	.00375"
Piston Pins:											
Length	2.573"	2.885"	2.885	2.954"	2.954"	2.954"	2.954"	3.363"	3.363"	3.363"	3.363"
Diameter	.937"	.937"	.937"	.9192"	.9192"	.9192"	.9192"	1.109"	1.109"	1.109"	1.109"
Pin Fit (Room Temperature 70° F.):											
Recommended Clearance in Rod	.0004"	.0004"	.0004"	.0004"	.0004"	.0004"	.0004"	.0006"	.0006"	.0006"	.0006"
Recommended Clearance in Piston	.0001" Loose to .0001" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight
Feeler Gauge Ribbon Checking											
Width	3/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Thickness	.003"	.003"	.003"	.003"	.003"	.003"	.003"	.004"	.003"	.003"	.003"
Tension on Scale (lb.)	6—12	10–18	10–18	5–12	5–12	6–18	6–18	5–9	3–6	3–6	3–6
Desired Tension (lb.)	9	14	14	9	9	12	12	7	5	5	5

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Connecting Rods:					
Connecting-Rod Bearing End Clearance	.007"—.013"	.007"—.013"	.007"—.013"	.007"—.013"	.006"—.010"
Connecting-Rod Bearing Clearance	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0025"—.0035"
Connecting-Rod Bolt Nut Tension (lb.-ft.)	80	80	80	80	105
Pistons:					
Material	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum
Recommended Piston Clearance					
Clearance Bottom of Skirt Minimum	.00125"	.00125"	.00125"	.00125"	.0065"
Clearance Bottom of Skirt Maximum	.00225"	.00225"	.00225"	.00225"	
Clearance Top of Skirt Minimum	.00325"	.00325"	.00325"	.00325"	.009"
Clearance Top of Skirt Maximum	.00425"	.00425"	.00425"	.00425"	
Piston Pins:					
Length	3.363"	3.550"	3.550"	3.800"	3.980"
Diameter	1.109"	1.109"	1.109"	1.109"	1.4999"
Pin Fit (Room Temperature 70° F.):					
Recommended Clearance in Rod	.0005"	.0005"	.0005"	.0005"	.003"—.007"
Recommended Clearance in Piston	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	.0000" to .0002" Tight	—.0001" +.0001"
Feeler Gauge Ribbon Checking:					
Width	1/2	1/2	1/2	1/2	1/2
Thickness	.003"	.003"	.003"	.003"	.005"
Tension on Scales (lb.)	7–11	4–7	7–11	7–11	5–10
Desired Tension (lb.)	9	6	9	9	8

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	FAC-241 FAC-241A	FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Piston Rings:											
Compression Rings:											
Number on Each Piston	3	3	3	3	3	3	3	3	3	3	3
Size	1/8"	3/32"	3/32"	1—3/32" 2—1/8"	1—3/32" 2—1/8"	1—3/32" 2—1/8"	1—3/32" 2—1/8"	1—3/32" 2—1/8"	1—1/8" 2—1/8"	1—1/8" 2—1/8"	1—1/8" 2—1/8"
Oil Rings:											
Number on Each Piston	1	1	1	1	1	1	1	1	1	1	1
Size	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"
Ring Diameter	3"	3 5/16"	3 5/16"	3 3/8"	3 1/2"	3 7/16"	3 9/16"	3 7/8"	4 1/8"	4 1/8"	4 3/8"
Ring Gap:											
Compression	.007"–.017"	.007"–.017"	.007"–.017"	.010"–.020"	.016"–.026"	.016"–.026"	.013"–.023"	.010"–.020"	.013"–.023"	.013"–.023"	.013"–.023"
Oil Control (Not U-flex)	.007"–.015"	.007"–.015"	.010"–.035"	.016"–.021"	.013"–.021"	.013"–.021"	.013"–.021"	.010"–.020"	.013"–.021"	.013"–.021"	.013"–.021"

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Piston Rings:					
Compression Rings:					
Number on Each Piston	3	3	3	3	3
Size	1—3/32" 2—1/8"	1—1/8" 2—1/8"	1—1/8" 2—1/8"	1—1/8" 2—1/8"	1—3/32" 2—3/32"
Oil Rings:					
Number on Each Piston	1	1	1	1	* 2
Size	3/16"	3/16"	3/16"	3/16"	1/4
Ring Diameter	3 7/8"	4 1/8"	4 1/8"	4 3/8"	4.8125
Ring Gap:					
Compression	.025"—.035	.025"—.035"	.025"—.035"	.025"—.035"	.013"—.023"
Oil Control (Not U-flex)	.025"—.035"	.025"—.035"	.025"—.035"	.025"—.035"	.013"—.023"

* Lower Ring is 3/16" Plain.

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	FAC-241 FAC-241A	FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Fit in Groove: Compression: Top	.0015"—.003"	.002"—.0035"	.002"—.0035"	.0025"—.004"	.0025"—.004"	.0027"—.0035"	.0027"—.0035"	.0025"—.004"	.0015"—.003"	.0015"—.003"	.0015"—.003"
Fit in Groove: Compression: 2nd and 3rd	.001"—.0025"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.002"—.0025"	.002"—.0025"	.002"—.0035"	.0015"—.003"	.0015"—.003"	.0015"—.003"
Oil Control	.001"—.0025"	.001"—.0025"	.001"—.0025"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"
Valves:											
Intake Valve:											
Stem Diameter	.372"	.372"	.372"	.342"	.342"	.342"	.342"	.434"	.434"	.434"	.434"
Angle of Face (See Note)	45°	45°	45°	45°	45°	45°	45°	15°	15°	15°	15°
Tappet Clearance (Hot)	.015"	.015"	.015"	.018"	.018"	.018"	.018"	.015"	.015"	.015"	.015"
Stem Clearance in Guide	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"
Width of Valve Seat	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"
Exhaust Valve:											
Stem, Diameter	.371"	.371"	.371"	.342"	.342"	.342"	.342"	.434"	.434"	.434"	.434"
Angle of Face	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°	45°
Tappet Clearance (Hot)	015"	.015"	.015"	.018"	.018"	.018"	.018"	.015"	.015"	.015"	.015"

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Fit in Groove: Compression: Top	.0025"—.004"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.005"—.0065"
Fit in Groove: Compression: 2nd and 3rd	.002"—.0035"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0025"—.004"
Oil Control: (Top)	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.003"	.0015"—.0035"
Oil Control: (Bottom)	.....	.....	.....	.....	.002"–.0035"
Valves:					
Intake Valve:					
Stem Diameter	.434"	.434"	.434"	.434"	.4973"
Angle of Face (See Note)	15°	15°	15°	15°	30°
Tappet Clearance (Hot)	.018"—.020"	.018"—.020"	.018"—.020"	.018"—.020"	.020"
Stem Clearance in Guide	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0015"—.0035"	.0008"—.0021"
Width of Valve Seat	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"	1/16"—3/32"
Exhaust Valve:					
Stem, Diameter	.434"	.434"	.434"	.434"	494"
Angle of Face	45°	45°	45°	45°	45°
Tappet Clearance (Hot)	.018"—.020"	.018"—.020"	.018"—.020"	.018"—.020"	020"

Note:

15° Intake Valves used in FBC engines starting with the following serial numbers:

FBC-318	Engine Serial No. 5682
FBC-318-A	Engine Serial No. 591
FBC-361	Engine Serial No. 1953
FBC-361-A	Engine Serial No. 648
FBC-401	Engine Serial No. 1189
FBC-401-A	Engine Serial No. 552
FBC-450	Engine Serial No. 1110
FBC-450-A	Engine Serial No. 664

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	FAC-241 FAC-241A	FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
VALVES—Continued:											
Exhaust Valve—Continued:											
Stem Clearance in Guide	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"
Width of Valve Seat	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"
Valve Tappet:											
Clearance in Block	.0005"—.0015"	.0005"—.0015"	.0005"—.0015"	.0005"—.003"	.0005"—.003"	.0005"—.003"	.0005"—.003"	.001"—.003"	.001"—.003"	.001"—.003"	.001"—.003"
Valve Springs:											
Free Length:											
Inner	2 11/16"	2 11/16"	2 11/16"	2 33/64"	2 33/64"	2 33/64"	2 33/64"	2 9/32"	2 9/32"	2 9/32"	2 9/32"
Outer								2 15/32"	2 15/32"	2 15/32"	2 15/32"
Length—Valve Open:											
Inner	1 15/16"	1 15/16"	1 15/16"	1 45/64"	1 45/64"	1 45/64"	1 45/64"	1 19/32"	1 19/32"	1 19/32"	1 19/32"
Outer								1 25/32"	1 25/32"	1 25/32"	1 25/32"
Lbs. Pressure—Valve Open:											
Inner	85½	85½	85½	93*	93*	93*	93*	45	45	45	45
Outer				116**	116**	116**	116**	90	90	90	90
Valve Rocker Arm Clearance on Shaft				.002"–.004"	.002"–.004"	.002"–.004"	.002"–.004"	.002"– 004"	.002"–.004"	.002"–.004"	.002"–.004"

*Without damper
**With damper

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED-401-A	RED-450 RED-450-A	R-6586
Valves—Continued:					
Exhaust Valve—Continued:					
Stem Clearance in Guide	.002"—.004"	.002"—.004"	.002"—.004"	.002"—.004"	.0035"
Width of Valve Seat	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"	5/64"—7/64"
Valve Tappet:					
Clearance in Block or Guide	.001"—.003"	.001"—.003"	.001"—.003"	.001"—.003"	.0002"—.0019"
Valve Springs:					
Free Length:					
Inner	2 11/32"	2 11/32"	2 11/32"	2 11/32"	2 7/8"
Outer	2 9/16"	2 9/16"	2 9/16"	2 9/16"	2 7/8"
Length—Valve Open:					
Inner	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 3/4"
Outer	1 45/64"	1 45/64"	1 45/64"	1 45/64"	1 3/4"
Lbs. Pressure—Valve Open:					
Inner	86	86	86	86	85
Outer	136	136	136	136	165
Valve Rocker Arm Clearance on Shaft	.002"—.004"	.002"—.004"	.002"—.004"	.002"—.004"	.0007"–.0009"

Engine Specifications—Continued

ENGINE MODELS	GRD-175 GRD-175A	GRD-214 GRD-214A	GRD-233 GRD-233A	(*) FAC-241 FAC-241A	(**) (***) FAC-259 FAC-259A	BLD-250	BLD-269 BLD-269A	FBC-318 FBC-318A	FBC-361 FBC-361A	FBC-401 FBC-401A	FBC-450A
Valve Timing:											
Intake Opens (After—Before T.D.C.)	10°—Before	10°—Before	10°—Before	2° (5°) Before	2° (5°) Before	5°—Before	5°—Before	5°—After	5°—After	5°—After	5°—After
Intake Closes (After L.D.C.)	40°	40°	40°	52° (45°)	52° (45°)	45°	45°	45°	45°	45°	45°
Exhaust Opens (Before L.D.C.)	45°	45°	45°	34½° (40°)	34½° (40°)	40°	40°	40°	40°	40°	40°
Exhaust Closes (After T.D.C.)	5°	5°	5°	9½° (10°)	9½° (10°)	10°	10°	10°	10°	10°	10°
Intake Valve Timing Checking Clearance	.020″	.020″	.020″	.016″(.023″)	.016″(.023″)	.023″	.023″	.0167″	.0167″	.0167″	.0167″
Oil Pump:											
Body Gear End Clearance	.003″	.003″	.003″	.0035″—.006″	.0035″—.006″	.002″—.004″	.002″—.004″	.0035″—.006″	.0035″—.006″	.0035″—.006″	.0035″—.006″
Pump Shaft End Play				.004″–.006″	.004″–.006″	.002″–.004″	.002″–.004″	.004″–.006″	.004″–.006″	.004″–.006″	.004″–.006″
Oil Pressure:											
Minimum (lb.)	5—10	5—10	5—10	10—15	10—15	10—15	10—15	10—15	10—15	10—15	10—15
At R.P.M.	300—350	300—350	300—350	300—350	300—350	300—350	300—350	300—350	300—350	300—350	300—350
Maximum (lb.)	20—30	20—30	20—30	40—45	40—45	40—45	40—45	40—45	40—45	40—45	40—45
At R.P.M.	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800
Cylinder Head:											
Cylinder Head Bolt (ft.-lb.)	65	65	65	80	80	80	80	105	105	105	105

Engine Specifications

ENGINE MODELS	RED-318 RED-318-A	RED-361 RED-361-A	RED-401 RED 401 A	RED-450 RED-450-A	R-6586
Valve Timing:					
Intake Opens (After—Before T.D.C.)	8° Before	8° Before	8° Before	8° Before	12° Before
Intake Closes (After L.D.C.)	52°	52°	5 °	52°	62°
Exhaust Opens (Before L.D.C.)	55°	55°	55°	55°	54°
Exhaust Closes (After T.D.C.)	15°	15°	15°	15°	20°
Intake Valve Timing Checking Clearance	.023″	.023″	.023″	.023″	.020″
Oil Pump:					
Body Gear End Clearance	.002″—.004″	.002″—.004″	.002″—.004″	.002″—.004″	
Pump Shaft End Play	.002″—.004″	.002″—.004″	.002″—.004″	.002″—.004″	
Oil Pressure:					
Minimum (lb.)	10—15	10—15	10—15	10—15	Idling 15
At R.P.M.	300—350	300—350	300—350	300—350	300—350
Maximum (lb.)	40—45	40—45	40—45	40—45	50
At R.P.M.	1500—1800	1500—1800	1500—1800	1500—1800	1500—1800
Cylinder Head:					
Cylinder Head Bolt (ft.-lb.)	105	105	105	105	110

Figures in brackets apply to—
*FAC-241 Engine Serial Number 2401 and above.
**FAC-259 Engine Serial Number 3301 and above.
***FAC-259-A Engine Serial Number 751 and above.

Green Diamond Engines

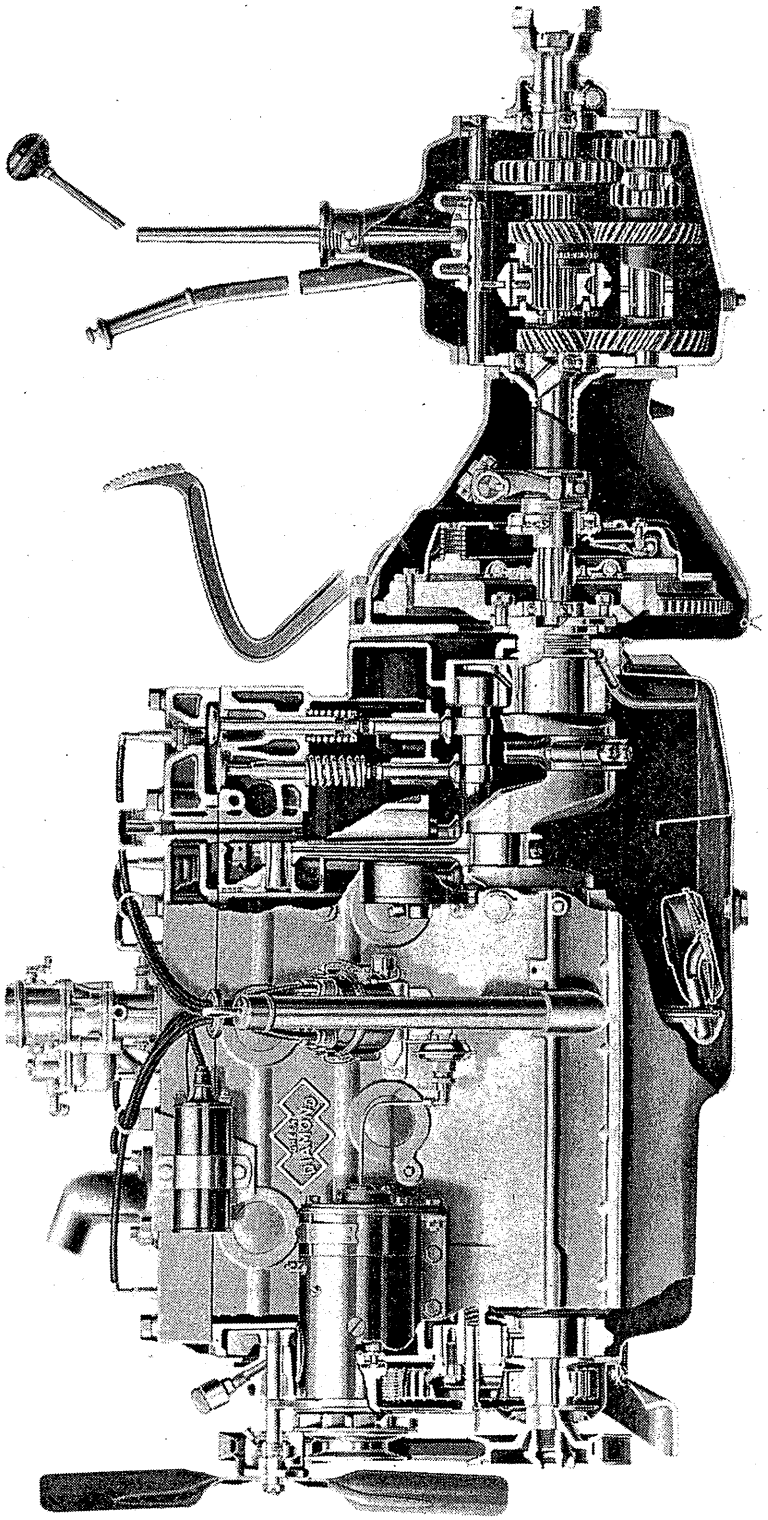

Fig. 1, Green Diamond 214 Series Engine

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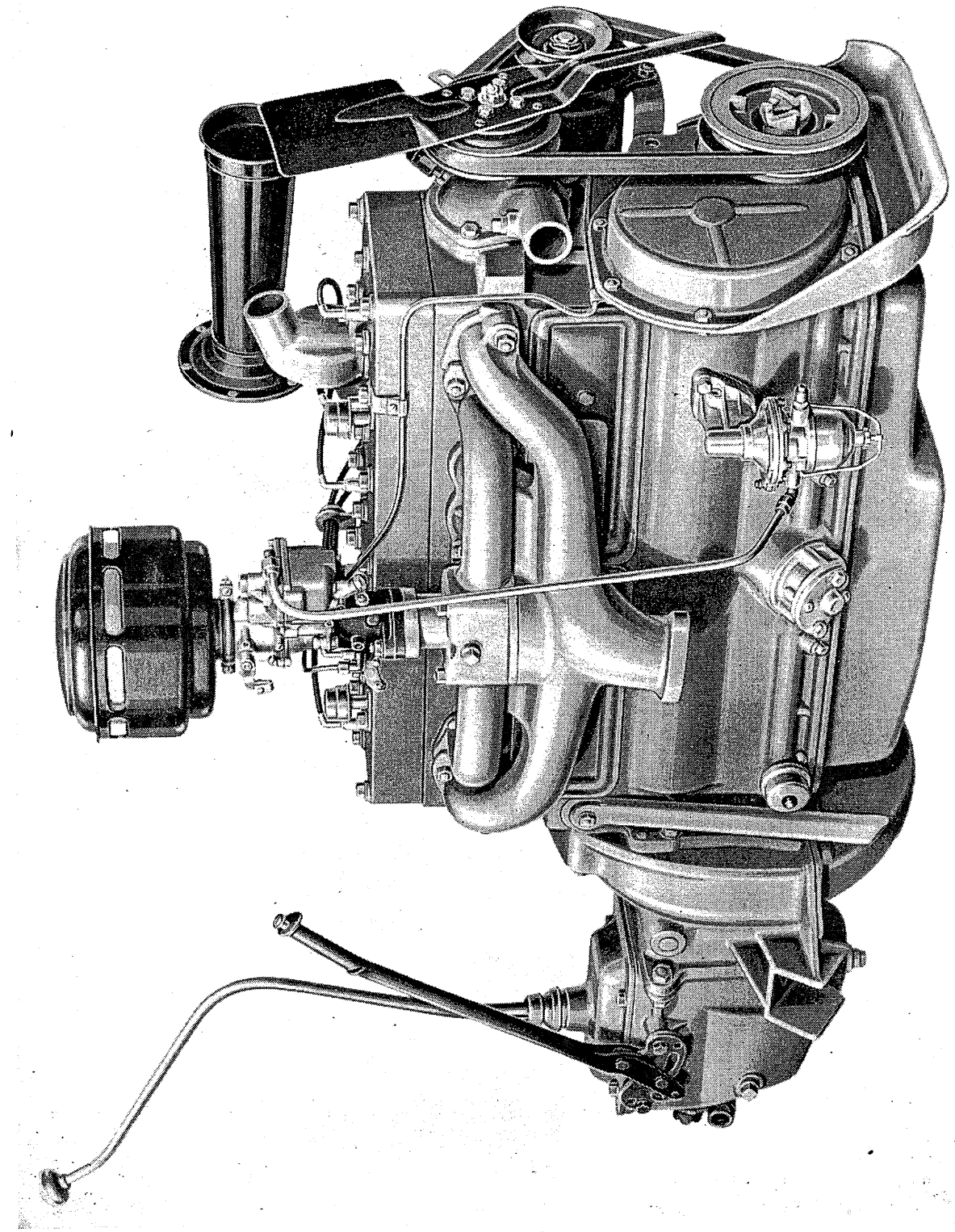

Fig. 2, Green Diamond 214 Series Engine

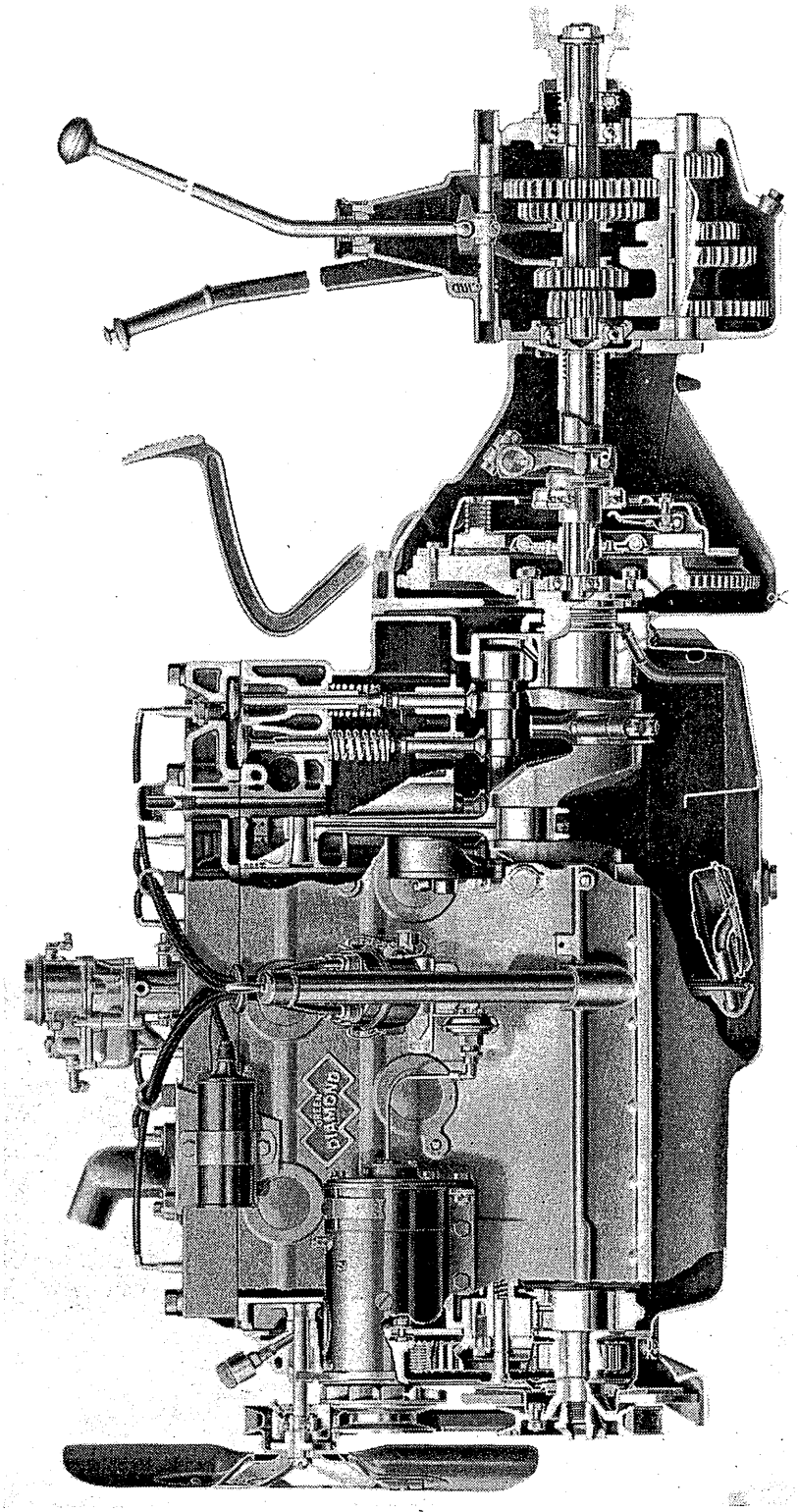

Fig. 3, Green Diamond 233 Series Engine

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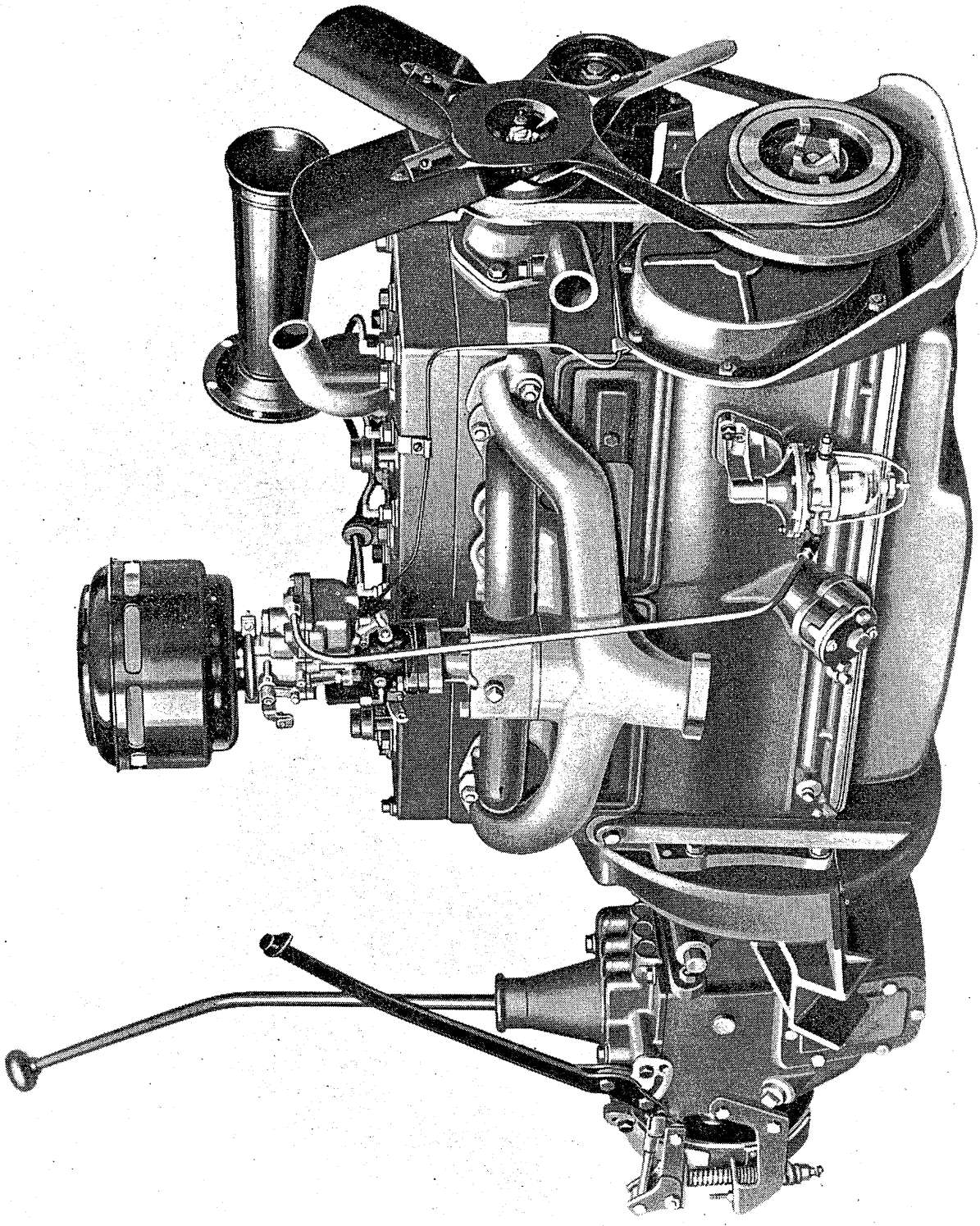


Fig. 4, Green Diamond 233 Series Engine

Engine Reconditioning

Best results in engine reconditioning will be obtained by observing the following descriptions and suggestions:

Cylinder Block

When reconditioning cylinder bores it is important that they be held to the specified limits. Bore diameters should be checked with an accurate gauge.

After honing, cylinder bores should be thoroughly cleaned to remove all abrasive material.

Pistons

Pistons should be fitted to specified clearances, (see Specification). Insert ribbon between piston and cylinder 90° from piston pin hole and in line with thrust face of piston. Piston inserting tool SE-1022 will facilitate piston fitting.

A feeler gauge set and tension scale combination is available which if used properly will facilitate the fitting of pistons.

Piston Rings

Examine cylinder bores before installing new pistons and rings. If necessary, the bores should be reconditioned, especially if they are out of round or tapered, or have a ridge at the top. If the ridge is not removed, with a ridge reamer when new piston rings are installed, trouble may be experienced with the top rings striking. It is always the best policy to recondition cylinder bores before installing new pistons or rings.

If new rings are being installed on old pistons the ring grooves should be thoroughly cleaned to remove all carbon.

The ring clearance in the groove is checked by rolling the ring around the piston and checking the clearance between ring and ring land with a feeler gauge of the specified thickness.

New rings should be fitted into the cylinders in which they are to be used before assembling on pistons. Put piston in cylinder, then insert piston ring, pushing it against head of piston to square it with cylinder. This check should be made with piston near bottom of cylinder where there usually is the minimum wear. Measure ring gap with thickness gauge. Another method of checking ring gap is to insert piston ring in cylinder, then use a piston to force ring down into lower portion of cylinder. This squares piston ring with cylinder. Then piston can be removed and the ring gap checked with the proper thickness gauge.

Install piston rings with the gaps staggered around the circumference of the piston.

Care should be exercised when removing or installing piston rings to prevent distortion. Suitable tools, should be used during this operation.

Piston Pins

Clearances specified for fitting pins in rods and pistons are based on a room temperature of 70° F. The general practice is to select pins that can be installed by pushing with palm of hand, first making sure that pin and bore are smooth and clean. Aluminum pistons should be heated to approximately 200° (F.) in boiling water and pin should be at room temperature.

Piston pins float in rod and piston and are held in piston by retainer rings that fit into grooves in piston pin bosses.

Piston pin bushing should be burnished with Burnishing Bar SE-894 and reamed to give clearances specified. Make sure that oil hole in rod indexes with oil hole in bushing.

Main Bearing and Connecting Rod Bearing Installation

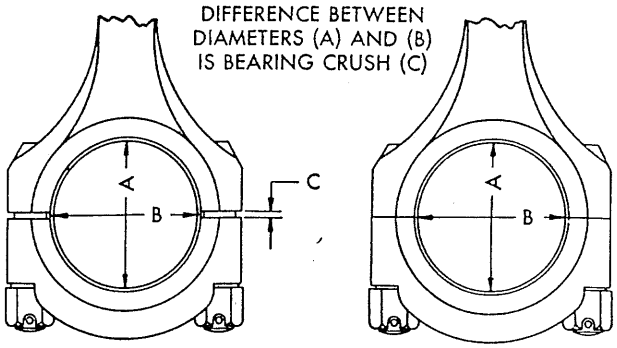
Bearing Crush

Undersize precision-type bearing shells should be installed when, because of wear, bearing-to-crankshaft running clearances are to be reduced. Bearing caps **must not** be filed, lapped, or in any other manner reworked.

Premature bearing failure wlll result from attempts to reduce journal-to-bearing running clearance by reworking of either bearing caps, bearings, or both. because such reworking will alter the engineered fit of the bearing shells in their bores and destroy the specifically desired "crush."

When installing precision-type connecting-rod or main bearings, it is important that the bearing shells fit tightly in the rod or case bore. To accomplish this, the bearing manufacturer makes the diameter at right angles to the parting line slightly larger than the actual diameter of the bore into which they are assembled. When the assembly is drawn up tight, the bearing is compressed, assuring a good contact between the bearing back and the bore. This increased diameter is referred to as bearing "crush." (Figure 5).

To obtain proper bearing assembly with the correct "crush," care must be taken when tightening the clamping bolts to make sure they are drawn



DIAMETER (A) AT RIGHT ANGLES TO PARTING LINES GREATER THAN DIAMETER (B)

WITH BEARING CAP DRAWN UP TIGHT DIAMETERS (A) AND (B) ARE EQUAL

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Fig. 5

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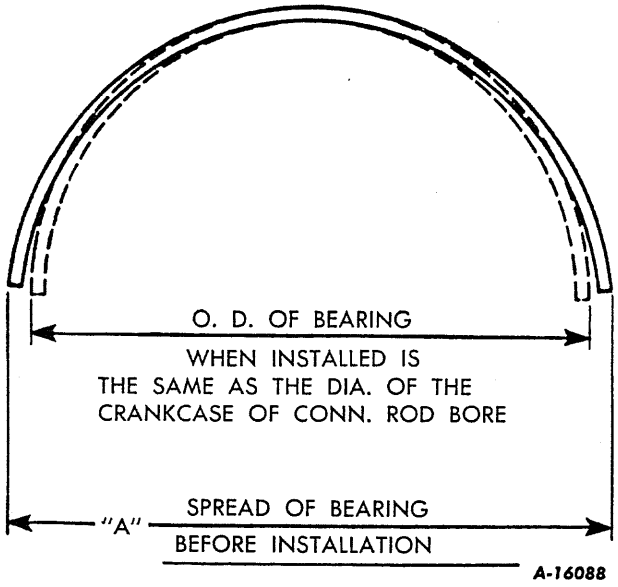

Fig. 6

down alternately and evenly, using a tension wrench and tightening as specified.

As a result of excessive bearing crush due to reworking the caps the rod or main bearing bore will possibly become distorted because more force is required to draw the cap and housing together.

Rods, caps, or blocks must not be filed, lapped, or in any other manner reworked in order to reduce clearance. While such practice will make a tighter fit at top and bottom, it will result in an out-of-round bore and bearing shell distortion. New bearing shells will have to be installed eventually and that is when additional trouble starts.

In general, a visual inspection of the parting faces of the rod or caps under a magnifying glass will provide sufficient proof of any attempt at reworking. Under the glass, the parting line surface of standard parts will show the manufacturing cutter tool marks and will not have a polished or extremely smooth appearance. On the other hand, reworked parts will have a polished surface and, if a file was used, will show the even pattern of the file teeth. Seriousness of this condition is in direct proportion to the amount of reworking.

Bearing Spread

Main and connecting-rod bearings are designed with the "spread" (width across the open ends) slightly greater than the diameter of the crankcase bore or connecting-rod bore into which they are assembled (Figure 6). For example, the width across the open ends of the GRD engine connecting-rod bearing not in place is approximately .025 inch more than when the bearing is in position in the rod. This condition causes the bearing to fit snugly in the rod bore and the bearing must be "snapped" or lightly forced into its seat.

Rough handling in shipment, storage, or normal results of use in an engine, may cause the bearing spread to be increased or decreased from the specified width. Bearing spread should, therefore, be carefully measured and corrected as necessary before installation in an engine.

Bearing spread can be safely adjusted as follows, although care and judgment should be exercised in the process:

(1) **Excessive spread.** If measurement of spread (Figure 6) indicates that distance "A" is excessive (see chart for specifications), place bearing on a wood block (Figure 7) and strike the side **lightly** and **squarely** with a soft mallet. Recheck measurement and, if necessary, continue until correct width (measurement "A" in chart) is obtained.

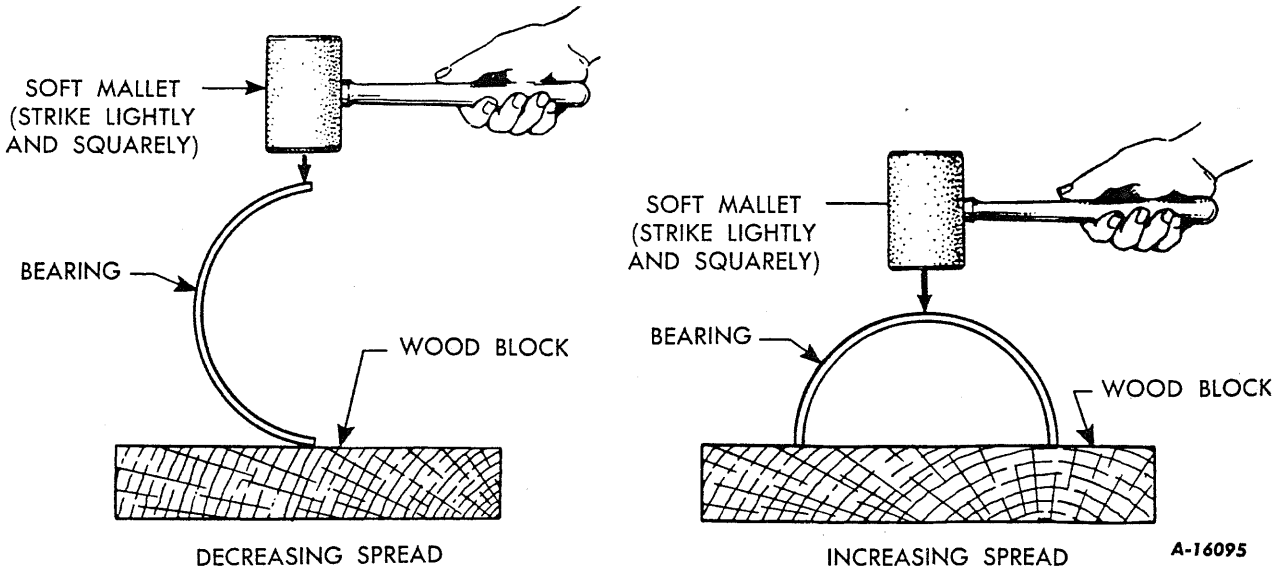

Fig. 7

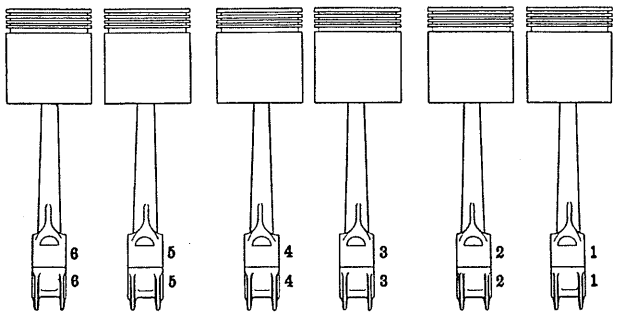

Fig. 8

(2) **Insufficient spread.** If measurement of spread indicates insufficient spread, place bearing on wood block (Figure 7) and strike the back of the bearing **lightly** and **squarely** with a soft mallet. Recheck measurement and, if necessary, continue until correct width (measurement "A" in chart) is obtained.

Chart of Bearing Spread Dimensions GRD Engine (Minimum)		
A	Connecting-Rod Bearing	2.1315″ (2.1065″ + .025″)
	Main * Bearing	2.8175″ (2.7925″ + .025″)

* Front bearing is flanged and requires less spread. Diameter is 2.7875″ (2.7825″ ± ·005″).

Checking Bearing Clearance

Bearing life, regardless of bearing make, type or material, depends upon correct installation. While installation using the paper-test method of checking bearing clearance has proved acceptable, it is not as accurate as the virgin (pure) lead method. Virgin lead in wire form is available in .015-inch diameter on one-pound spools. Recommended procedure for checking bearing clearance with virgin lead is outlined as follows:

1. Clean bearing contact surfaces. Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.
2. Coat crankshaft journal with heavy mineral oil to help centralize crankshaft, bearings and cap.
3. Place a short piece of virgin (pure) lead wire about 1½ inches long **lengthwise** on crankshaft journal.
4. Install bearing cap and shell assembly. Install capscrews. CAUTION: If bearing capscrews show enough run-out when screwing into cap and case to cause bearing cap to move sidewise, it should be replaced as it is not possible properly to aline bearing cap unless the cap can centralize itself through the oil film on crankshaft journal.
5. Tighten main bearing capscrews intermittently to 30, 60, 85 and 105 foot-pounds, moving crankshaft ⅛th revolution back and forth twice after each time the capscrews are tightened. Moving crankshaft as specified will properly iron out the lead wire. (Do not move the crankshaft more than twice or over ⅛th revolution after each tightening of the capscrews.)
6. Remove bearing cap and bearing shell and carefully peel off flattened piece of lead and measure with a micrometer. Measured thickness is amount of clearance present.
7. Connecting-rod bearings can be checked in the same manner as outlined for main bearings (as in 6 and 7) except the capscrews of the connecting rod should be tightened to only 80 foot-pounds.
8. Connect an oil leak detector and observe amount of oil leakage or run-off at bearings. If the leakage appears in drops of such size and shape as to be almost a stream, that particular bearing is open to suspicion and should be invetigated. If no leakage at all is observed, the bearing may be fitted too tightly or an obstruction in the oil lines may exist. Investigate—there must be some leakage of oil. Oil leakage should be in **well-defined drops.**
9. Tighten main bearing cap bolts and connecting-rod bolts to specified tensions. (See specifications.)

Connecting Rods

Connecting-rod and piston assemblies are removed through the top of the block.

Cylinder numbers are stamped on a flat space on rod and cap, and rods should always be assembled with these numbers toward camshaft side of crankcase. (See Figure 8.)

No shims are used in Green Diamond connecting rods.

Connecting rods of this engine are offset: Rods for cylinders 1, 3, and 5 are installed with the offset toward the rear, and rods for cylinders 2, 4, and 6 are installed with the offset toward the front of the engine.

Main Bearings

Numbers stamped on bearing cap bosses indicate position for installation. Number should face camshaft side of crankcase. The small tongues on main bearings should fit snugly into grooves in crankcase and main bearing caps.

IMPORTANT: Before installing new bearings be sure to clean out drilled oil passages in crankshaft and block. A rifle barrel brush or a brass rod should be run through the oil passages to dislodge any sludge, grit or bearing material. Plugged oil passages will prevent adequate lubrication to the new bearings, resulting in early failure.

It is recommended that a complete set of main bearings be used when replacement is made.

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Main bearings can be replaced without removing the crankshaft, although it may be necessary to remove timing chain so that crankshaft can be dropped. All main bearing caps should be loosened slightly.

Remove No. 1 bearing cap and by lightly tapping the plain edge of the upper half bearing, and in some cases turning the crankshaft in the direction of rotation, the bearing shell is easily removed. Installation is accomplished in reverse manner.

The balance of main bearings are removed and installed in the same manner.

Be sure that the seats for the bearings as well as the backs of the bearing shells are clean and free from oil. A good contact is absolutely essential.

It is essential that main bearings be in alignment with the crankshaft journals. The GRD engines do not have the bearing caps piloted in the crankcase. When no means of piloting the bearing caps has been provided, misalignment is possible due to a slight shifting of the bearing caps when the bearing cap bolts are tightened. If a bearing cap bolt is not straight or if the threads are not concentric with the body of the bolt, this condition will be aggravated; therefore, all bolts should be carefully examined before installation to avoid such a condition.

The following method has proven successful in holding the caps and bearings in alignment with the crankshaft. After bearings have been fitted to specified clearances, remove the caps, and apply a coating of petrolatum or white vaseline or heavy engine oil to the bearing surfaces, then reassemble the caps and tighten the bolts.

It will be noted that a small quantity of the lubricant may be squeezed out when the bearing caps are tightened; however, a sufficient quantity will remain which will serve as a cushion or filler between the bearings and crankshaft journals, thereby reducing the tendency of the cap and bearing to shift.

The petrolatum or vaseline or heavy engine oil will also serve as a lubricant when the engine is first started and will dissolve and mix with the regular engine lubricating oil after a few revolutions.

Under no circumstances should anything other than petrolatum or vaseline or heavy engine oil be used due to the possibility of chemical reactions which would cause damage to the bearing material.

Crankshaft

Crankshaft journals and crankpins should be checked for taper and out of round. If this exceeds .003″ it is recommended that the shaft be reground. Examine the bearing surfaces for flat spots, grooves, or scores, and if excessive, the shaft should be reground or replaced.

Shims are provided between the crankshaft and the crankshaft thrust washer at the front end. Their purpose is to maintain the specified end play of the shaft at .002″ to .006″.

Camshaft

Examine camshaft bearing journals and if grooved or scored, shaft should be replaced.

Camshaft Bearings

In the Green Diamond Series engines only the front camshaft bearing is replaceable, the second, third, and rear bearings being integral with the crankcase.

The bearing must be installed so oil hole indexes with oil supply hole in cylinder block. This is important to insure sufficient lubricant to bearing.

The bearing must be line-reamed to size after installation in crankcase.

SE-1169 Bushing Removing and Installing Tool is available for replacing the bushing. Camshaft Bushing Line-Reamer SE-1168 must be used for properly reaming this bushing.

Vibration Dampener (GRD-233 Engine)

This unit is attached to the rear of the fan drive pulley by six capscrews. Be sure the nuts and lock washers on the capscrews are tight.

If necessary to remove the fan drive pulley and vibration dampener assembly, the starting jaw nut should first be removed, then insert two long capscrews in the holes in pulley and use a puller to remove the assembly.

By unscrewing the nuts from the six capscrews the pulley and vibration dampener can be disassembled.

A locating dowel in the fan drive pulley insures correct reassembly in relation to the ignition timing notch which is on the outer rim of the vibration dampener. It is important that the pulley and vibration dampener be assembled correctly in order that the ignition timing notch will be in the proper position.

Under no circumstances should the crankshaft vibration dampener be permanently removed from the engine.

The fit of the dampener hub on the crankshaft must be tight (.0005″ to .002″ press fit). If there is less than .0005″ press fit between the hub and shaft a new hub should be installed.

Dampener hubs may be heated in boiling water to facilitate installation.

CAUTION: Do not wash vibration dampeners in kerosene or any other fluid that is injurious to rubber.

Do not permit this unit to become saturated with oil or grease, otherwise rapid deterioration of the rubber will result.

Flywheel and Clutch Housing

Proper alignment of flywheel and clutch housing is of extreme importance.

To check alignment and make adjustments the following method should be employed, using checking equipment similar to SE-1094.

1. Remove floor boards, disconnect pedals and propeller shaft.
2. Remove transmission and throw-out shaft, bearing, and clutch.
3. Engine must be supported before removing these parts.
4. Attach indicator as shown and check bore "A." Flywheel and clutch housing is doweled to crankcase at "X" and when correctly aligned runout of bore "A" should not exceed .005" total indicator reading. (See Figure 9.)
5. If reading indicates misalignment beyond recommended limits, remove dowel pins and loosen housing attaching bolts sufficiently to permit movement by tapping lightly with a hammer.
6. Set indicator in position showing maximum runout, and tap housing slightly to shift its position until indicator reading is ½ of maximum reading. Recheck runout by rotating crank. The resultant reading should approach .000" or at most, less than .005" runout.
7. Tighten attaching bolts and reindicate. Ream dowel holes, using an oversize reamer that will produce a .001" to .002" drive fit of an oversize dowel.
8. Install oversize dowels and reindicate. If these are not available, they can be made from a piece of drill rod the desired size.

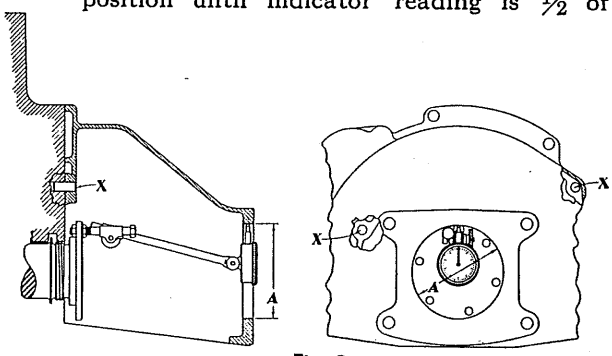

Fig. 9

Reconditioning Valves and Seats

Valve reconditioning can be more easily accomplished by stripping the sheet metal fenders and grill work off **as a unit.**

Valve-Seat and Face Angles

One of the principal difficulties experienced in reconditioning valves is obtaining nearly **identical angles on the valve seat and valve face.** The importance of these angles in the grinding operation cannot be overemphasized, because it is **impossible** to produce a flat or square seat by lapping.

The grinding stones on both the valve-refacing machine and valve-seat grinder should be dressed before starting a reconditioning job. You will be unable to determine how closely the angle of the seat will match the valve face until the valve and seat have been ground and a check made with a very light tint of Prussian blue. If a full seat-width contact around the entire circle of seated valve is not shown, the angles do not match. It will then be necessary to redress the valve-seat grinding stones, changing the angle sufficiently to correct the error. The correction should be made on the valve seat, and **not on the valve.** No more material should be removed from the valve face than is necessary to true it up and remove the burned or pitted portion. New valves should not be refaced, but should be checked for trueness. When a satisfactory match of valve-seat and valve-face angles has been obtained, the adjustment of both the valve refacer and the seat grinder should be locked in position, in order to eliminate this trial by error method on additional valves having the same angle.

CAUTION: To obtain an accurate check, use a very light trace of Prussian blue.

Valve Lapping

A poor grinding job cannot be corrected by valve lapping. Any attempt to do so will result in rounding off the surfaces, providing an improper seat.

The purpose of valve lapping is merely to impart a polish to the contacting surfaces after the valve face and seat have been reground to the same angles. For this reason, only a few passes with a **fine** compound will be required. A **coarse compound must never be used** as this will groove or ring the surfaces and destroy the results of a good grinding job.

Valve Seats

The primary purpose of a valve seat is to seal the combustion chamber against pressure losses and to provide a path to dissipate the heat accumulated in the valve head so as to prevent burning of the seat and warping of the valve head.

The location of the valve seat on the valve face and its width controls the amount of valve head that protrudes into the combustion chamber. It is obvious that the greater the exposure within the combustion chamber, the higher the valve temperature, or in other words, the more heat it will collect. High valve temperatures and poor heat dissipation also produce excessive valve stem temperatures and hasten the accumulation of carbon on the stem, causing them to stick in the guides.

Seat Widths

In general, the width of exhaust seat should range between the average and maximum specifications and the intake seats between the minimum and average specifications. The intake seats may be narrower than the exhaust because they are usually larger in diameter, thus providing a total seat area approximately equal to smaller exhaust valve with the wider seat. Also the less severe heat conditions do not require as large a seat area for heat dissipation purposes.

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There are also objections to an excessively wide seat, a few of which are as follows:

(a) In city or light delivery service a wide seat collects carbon and particles of dirt that will produce variations or loss of compression, resulting in poor idle and possibly a loss of general performance and economy.

(b) A wide seat in severe service operating in the presence of dirt or an excess of carbon will produce a badly pitted seat which may be just as detrimental to valve life as a too narrow seat. Under these conditions a seat width to the minimum limit would possibly be better; however, the source of trouble which is the dirt and excessive carbon should be eliminated, making it possible to retain the wider seat.

Sketches (B) and (C) in Figure 10 and the tabulation of the seat widths will provide a condition that will prolong valve life. The sketches are to scale so that the recommended proportion of seat width to valve face width and also the proper location of the valve seat on the valve face can be readily seen. In general, the seats are centrally located or slightly above center.

Valve Clearance Adjustment

Proper clearance between valve stems and valve tappet adjusting screws must be maintained in order to obtain satisfactory operation.

Before making an adjustment, run engine sufficiently to thoroughly warm it up. This is important.

Recommended valve clearance for quiet operation is .015″ hot or .018″ cold. For severe service set valves at .017″ hot or .020″ cold.

Valve-Stem Guides

Press valve-stem guides in from top of cylinder block to dimension shown with tapered end up. (See Figure 11.)

After installation, ream valve guides to .3745″–.3755″. Reaming should be done carefully and slowly—do not force reamer. A smooth finish is essential as the amount of bearing surface between valve stem and guide is dependent upon finish of guide bore.

After reaming valve guides, check valve seats, and if runout exceeds .002″ to .003″, seats should be refaced. When refacing valve seats the tool must be piloted in valve guide.

Valve-Seat Inserts

Necessity for replacing valve-seat inserts should be very rare; however, if a replacement is made it is important that new inserts be peened securely in place, using either an insert peening tool or a dull-pointed chisel, ¼″ wide, to peen cylinder block metal over outer edge of valve-seat insert (see Figure 12).

Valve-seat inserts supplied for service are standard size and .030″ oversize, which permits a good tight fit in cylinder block. Letter (M) is

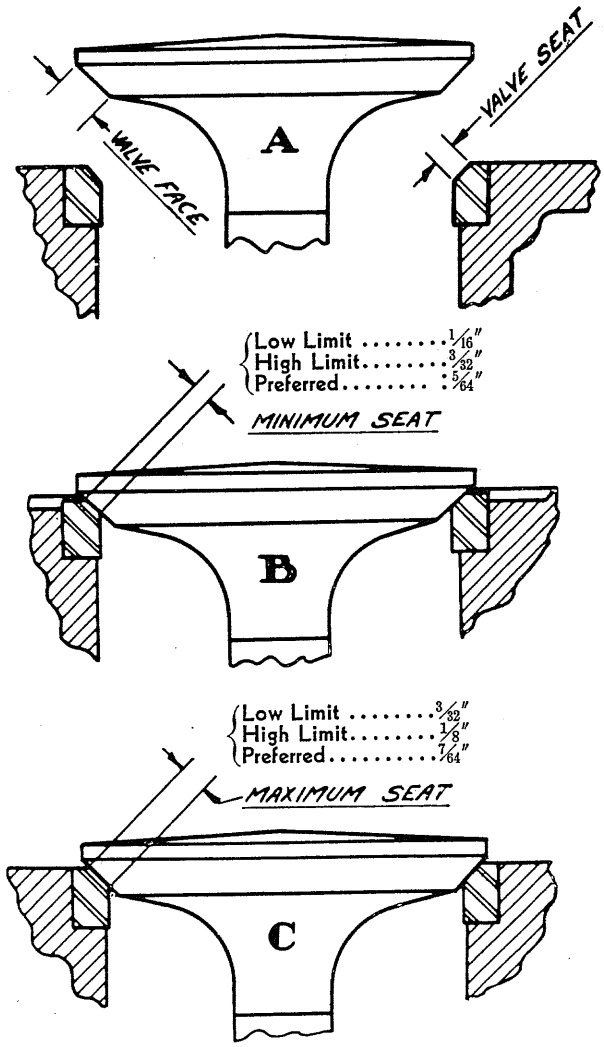

Fig. 10

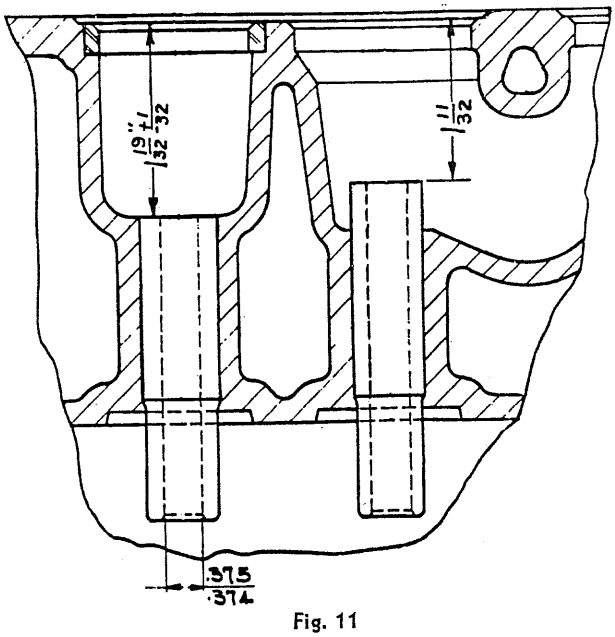

Fig. 11

stamped on **top** of molybdenum iron inserts. Stellite inserts are marked 'S' on **bottom.**

Valve seat insert replacement tools are available and must be used.

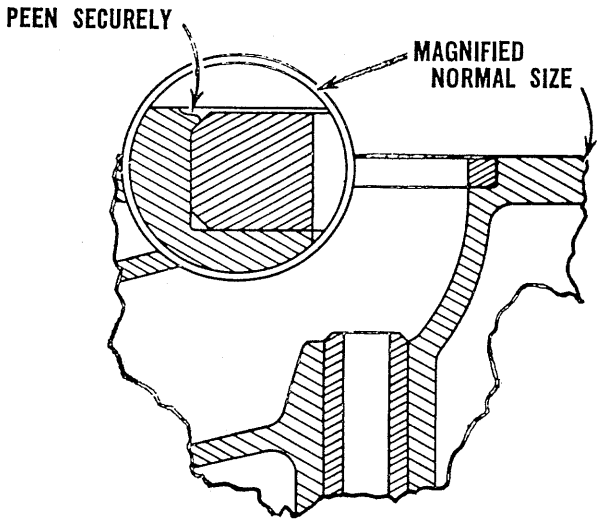

Fig. 12

Cylinder Head

Figure 13 illustrates correct order in which cylinder head should be tightened. This is important to assure a good seal between cylinder head, cylinder head gasket, and cylinder block and will also avoid strains in cylinder head casting.

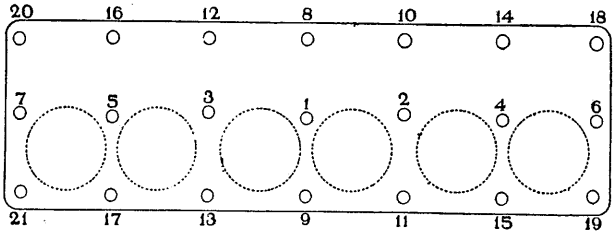

Fig. 13

A Tension Indicating Wrench should be used. Recommended tension for Green Diamond engine cylinder head capscrews is 65 ft.-lbs.

To guard against compression or water leaks, coat both sides of the cylinder head gasket with a suitable, clear sealing compound, such as shellac. Let gasket dry until the coating becomes tacky, then install with smooth side up, as stamped, first making sure that block and head are smooth and clean.

Install gasket with small graduated water holes toward the valve side of the engine. This will place the large water holes toward the rear of the engine and provide better circulation.

After cylinder head has been tightened, run engine for a few minutes, and retighten to 65 ft.-lbs.

Valve Tappets and Guides

Valve tappet guides are integral with crankcase.

Camshaft must be removed to disassemble valve tappets.

Valve Springs

Valve springs should be square in their seats and also should be checked with a Valve Spring Tester to determine if they meet specifications. This should be done at every valve grind and replacement made when necessary.

Install valve springs with close-coiled end to cylinder block.

Ignition Timing Marks

On Green Diamond Series engines, an ignition timing indicator or pointer is attached to the front gear cover, just above the fan drive pulley (see Figure 14). This pointer, when opposite the notch in fan drive pulley or vibration dampener, indicates the correct ignition timing position. There are no timing marks on the flywheels of engines having the pointer on the front gear cover.

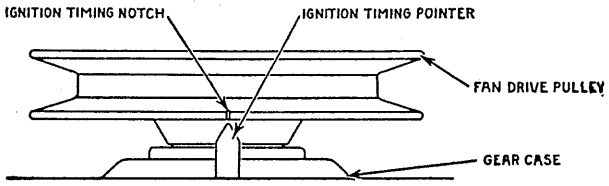

Fig. 14

Timing Chain and Sprockets

The camshaft in GRD engines is chain-driven.

Sprockets should be removed or installed, using a puller or pusher tool.

They must be installed so that the crankshaft and camshaft are in correct relation to each other. The sprockets are marked and should be installed so that the marks on camshaft and crankshaft sprockets match. **Extreme care must be exercised in matching these gear marks.** (See Figure 15.)

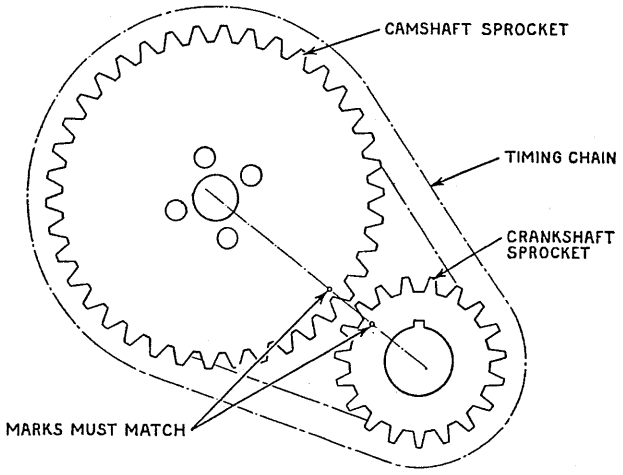

Fig. 15

A timing gear indicator is available under SE-1193 for assistance in establishing correct alignment as shown in Figure 16.

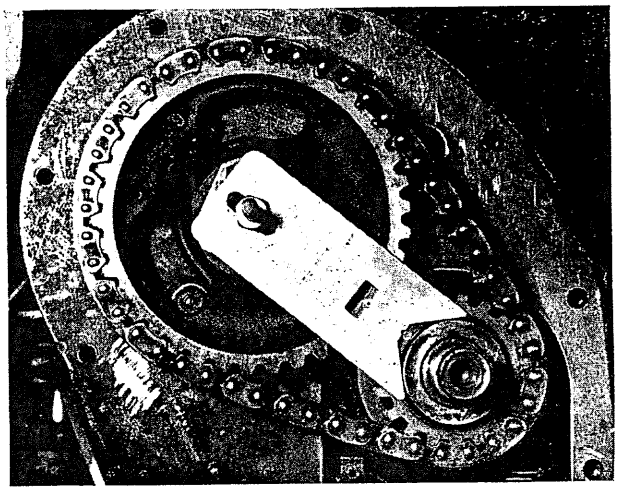

Fig. 16

Water Pumps

The water pump used on GRD engines of earlier production contained a packing nut and lubricant fittings. This design was later replaced by the packless or mechanical seal type pump shown in Figure 17. Detailed instructions illustrating the proper servicing of both types of water pump is given in the revised edition of Shop Talk No. 14.

NOTE: The bearing used in the mechanical seal pump is prelubricated. No further lubrication is necessary.

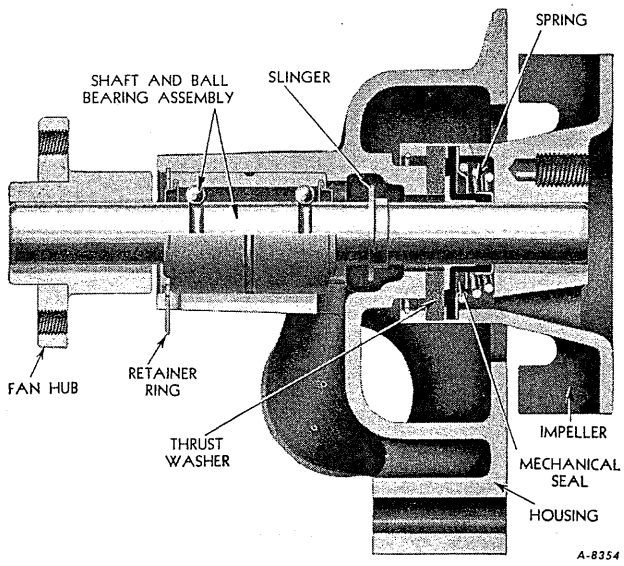

Fig. 17

Fan Belt Adjustment

Fan belt should run under proper tension. Adjustment is made by loosening generator mounting screws and generator brace capscrew, after which generator can be moved in or out as required.

Proper tension is obtained when belt can be depressed approximately ½" as shown in Figure 18.

After adjustment has been made be sure to tighten all capscrews.

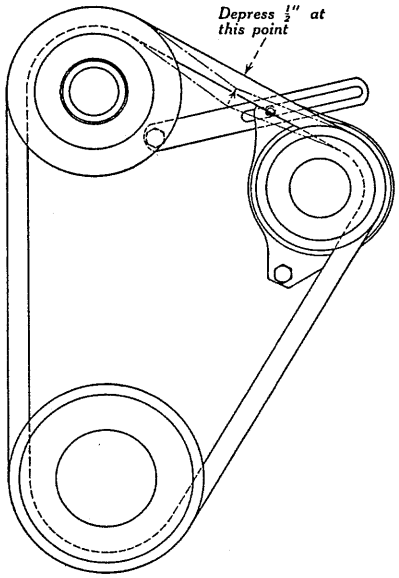

Fig. 18

Exhaust Pipe Seal Ring

The assembly of the exhaust pipe seal ring is shown in Figure 19.

Be sure that seal ring seats squarely against exhaust manifold, exhaust pipe and flange, and tighten stud nuts evenly in order to prevent distortion of exhaust pipe and possible breakage of exhaust pipe flange.

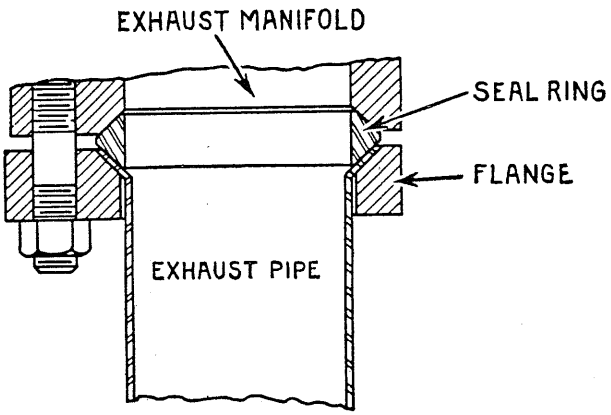

Fig. 19

Oil Seals and Gaskets

Correct assembly of oil seals, retainers and gaskets is of extreme importance in preventing oil leaks.

Figure 20 illustrates the assembly of the crankshaft front seal, retainers and oil pan gaskets, and Figure 21 illustrates the rear assembly.

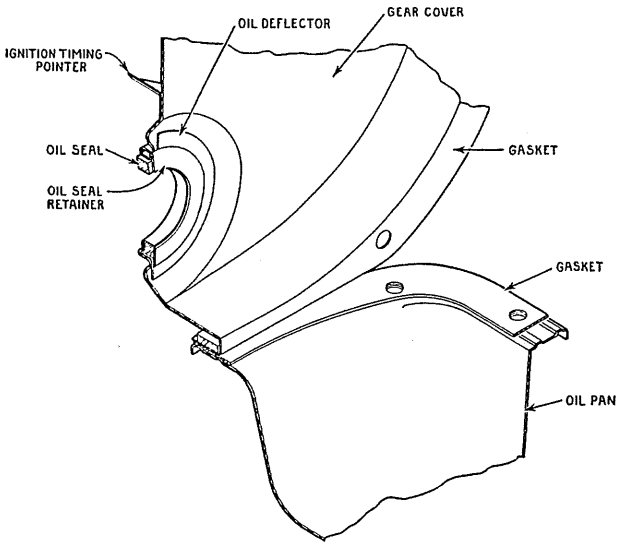

Fig. 20

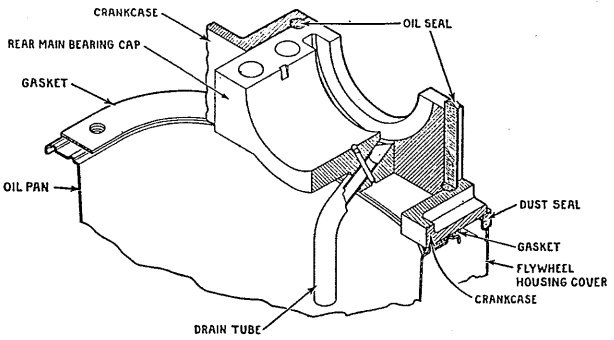

Fig. 21

Make sure when replacing seals or gaskets that no foreign matter is adhering to the surfaces. Such would prevent proper contact.

Dip felt seals in oil before assembly.

Flywheel and Crankshaft Assembly

The flywheel is assembled to the crankshaft with four bolts and two body-fit dowel bolts.

All holes in the flange of new crankshafts or flywheels are straight, therefore it is necessary to ream the two large holes that are directly opposite each other, using Reamer Tool SE-1209, in order to permit the installation of the body-fit dowels.

The two holes to be reamed should match on flywheel and crankshaft flange. Be sure nuts on dowel bolts as well as on the other four are drawn up tight.

Water Thermostat

The water thermostat in Green Diamond engine is a balanced valve type having two outlets which are controlled by two valve discs mounted on a common shaft and incorporating one external balancing disc to prevent water pressure from disturbing the true temperature control during the opening and closing cycles.

This thermostat is nonadjustable and is set to start to open at 145 to 150° F. The use of the thermostat shortens the warm-up period and reduces crankcase condensation and dilution.

Thermostats of higher operating temperature are available through the Repairs Department if desired.

The operation of the thermostat can be checked by placing it in still water and heating the water. A reliable thermometer should be used, and at a temperature of approximately 145 to 150° F. the valves should start to open and be fully opened (¼" approximately) at around 200 to 205° F. This applies only to a still-water test.

If the thermostat does not function as outlined above, a new one should be installed.

Figure 22 illustrates the construction details of the thermostat.

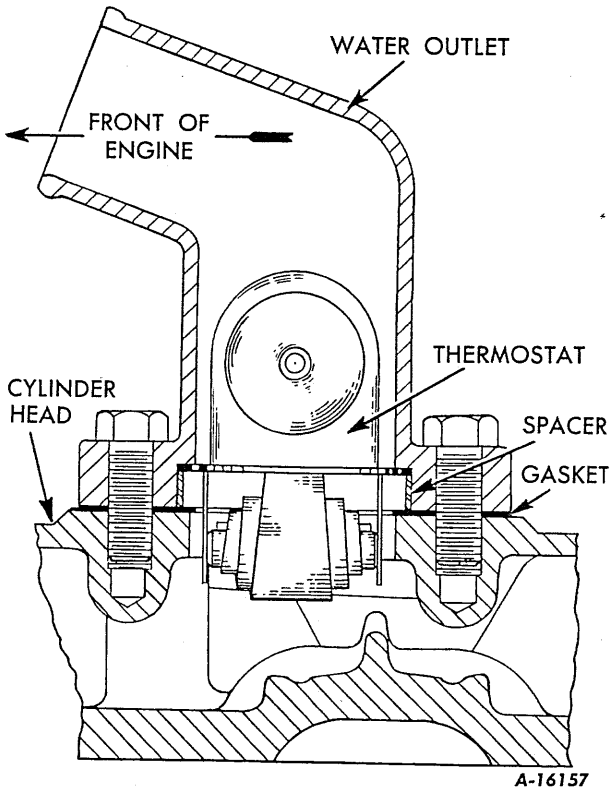

Fig. 22

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Oil Pump

Detailed instructions illustrating disassembly and reassembly of the oil pump is given in Shop Talk No. 28. Figure 23, shows construction of the GRD oil pump.

If oil pump has been removed, the ignition distributor must also be removed before reinstalling the pump. This is due to the fact that the slot in the end of the oil pump drive shaft is off center and this slot must match the tang on the ignition distributor shaft (see Shop Talk No. 28). If an attempt is made to install the oil pump assembly without first removing the distributor it will be impossible to align the slot and tang, with the result that the pump will be damaged when the pump mounting bolts are tightened.

After installing the oil pump assembly it is an easy matter to align the ignition distributor and oil pump shafts.

NOTE: When oil pump has been removed from the engine it will be necessary to retime the ignition.

Engine Mountings

Some special fabric insulators were used instead of rubber at the engine front and rear mountings. The front mountings use long bolts and compression springs and should be tightened until the springs are compressed to $2\frac{3}{4}$" in length. The rear mountings use insulators and bolts which are drawn up snug. Install self-locking nuts on both front and rear mountings.

NOTE: Do not install rubber insulators at one rear mounting and fabric insulators at the other. This also applies at the front mountings, using fabric insulators and compression springs. (Service Bulletin No. 32-1943 shows detailed sketches of the above mountings).

Engine mountings of present design use rubber insulators together with self locking nuts. The procedure for assembling the engine mounting parts is as follows:

1. The mounting rubbers must be seated in the castings, and on the cross member, the standard hex nut should be tightened by hand and then given one additional turn with a wrench to assure proper compression of the rubber mountings.

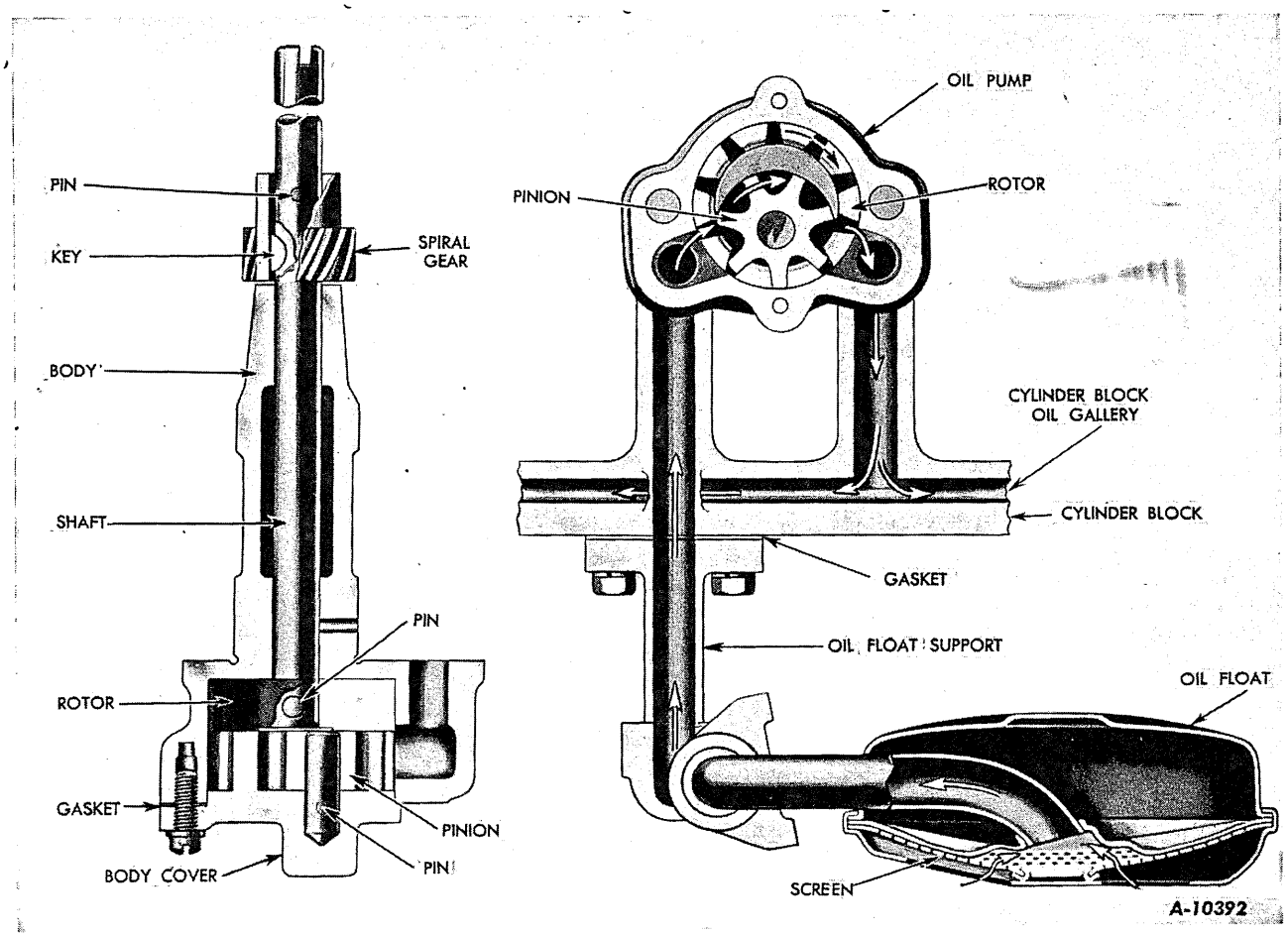

Fig. 23

2. Install the self locking nut turning it down against the hex nut. It is desirable to have at least three full threads available for the self locking nut. Tighten the self locking nut about ⅓ turn with a wrench. **NOTE:** Be sure the wrench does not engage the standard nut and that its position does not change when tightening the self locking nut.

Removal is accomplished by first removing the self locking nut, then the standard nut.

NOTE: Do not attempt to remove both nuts at the same time. If the self locking nuts have been properly installed and removed they may be used several times. Do not attempt to reuse self locking nuts whose sides have been distorted, or the spring jaws flattened due to excess tightening. (Service Bulletin No. 39-1941 shows detailed sketches of the present type mountings).

Oil Pressure Control

Oil pressure is controlled by the pressure valve spring located in the oil pressure regulator. Oil pressure should be checked when engine is hot and oil is warm.

When low oil pressure is encountered, a systematic and thorough investigation is necessary in order to determine the cause.

The following are the principal causes for this condition and it is recommended that these be thoroughly checked in the order named, which in all probability will result in the definite cause being determined.

Oil Supply

Excessively diluted condition or insufficient amount in crankcase.

Oil Pressure Gauge

Improper registration of gauge.
Loose connections.

Oil Pressure Regulator or Oil Filter (When Used)

Clogged condition of filter element.
Pressure valve not holding.
Weak pressure valve spring. Check by installing spacers in back of spring. Free length of spring should be 1⅜".

Oil Pump

Clogged condition of screen.
Gear cover gasket faulty.
Excessive clearance between gears and cover plate.
Specified gasket thickness, .003".
Worn condition of gears, allowing loose mesh.

Main, Connecting-Rod, and Camshaft Bearings

Excessive running or end clearances.
Out-of-round condition of bearings or journals.
Imperfect bearings—badly pitted or chipped.

Oil Leak Test Equipment

In order to check main, connecting-rod and camshaft bearing clearances to determine if they are excessive and the cause of low oil pressure, the following equipment and method have been found effective.

A test tank can be made (if test equipment SE-1632 is not available) from a piece of 4" pipe approximately 24" long. Weld a plate or base on one end and thread the other end to take a cap. Drill and tap the cap to take a tee connection and in one side insert a tire valve and in the other a pressure gauge registering to at least 75 pounds.

Drill and tap a hole near the bottom of the pipe so that a valve can be installed, and to the valve attach a flexible hose.

This test fixture can be made from a small tank, if one is available, or any other suitable material.

The tank should not be more than half full of SAE-10 or a heavier grade of heated oil, and in the case of the tank described above, 2 or 3 quarts will be sufficient. Tank can be filled by removing tee connection. (See Figure 24.)

The flexible hose should be connected to the oil pressure connection in the engine.

Apply air pressure to about 50 pounds, then open valve in bottom so that oil will be forced into oil channels and bearings. Inspect for excessive leakage and spray-off, which denotes excessive clearance and likewise pressure loss.

NOTE: If oil filter is used, remove filtering element and clean out base so that dirt collected in filter will not be forced into oil channels of engine. **The filter element should be left out when making this test.**

Breathers

Two-cup type breathers, filled with crimped copper wire to prevent any possibility of dirt entering, are installed in the cylinder head. An opening, through the head and block, into the valve spring compartment, permits gasoline and water vapors to escape, thereby reducing condensation and corrosion of valve springs.

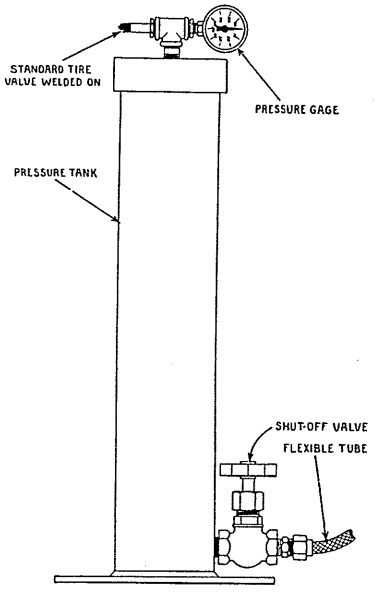

Fig. 24, Test Tank

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A ventilator pipe at the rear end of cylinder block permits the escape of these vapors from the crankcase.

Cleaning of Engines

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed.

The entire cylinder block casting should be thoroughly washed with a strong cleaning solution which will remove dirt, sludge, and carbon formations that may have accumulated. Particular attention should be paid to any recesses in the cylinder block and crankcase where an accumulation of dirt, sludge, or carbon might be found.

If the cylinder block is not thoroughly cleaned before reassembling there will be the possibility of dirt and carbon jarring loose when engine is being run in. This accumulation will be circulated through the oiling system with the result that bearings, crankshaft, camshaft, pistons, valve stems, etc., will be damaged.

All finished surfaces should be lubricated to prevent rust formation. The inside of the crankcase should then have all exposed casting surfaces (not machined surfaces) painted with a good special sealer paint.

The oil filter should be thoroughly cleaned, removing any accumulation of sludge and dirt from the sump in the base. Replace filtering element if necessary.

It is a good policy to disassemble and thoroughly clean all parts of the oil pump. This will permit checking fits and enable the mechanics to determine the parts needing replacement.

Fuel pump should be thoroughly cleaned, especially the small breather located in the body. This breather can be removed and flushed around in a cleaning fluid which will remove all dirt.

Oil in air cleaner should be changed. Clean out air cleaner cup. Make sure all connections are tight so that dust and dirt cannot enter. See detailed instructions under "Air Cleaner"—Fuel System.

Disassemble carburetor and clean thoroughly. Do not run a wire through jets as this will enlarge the holes, thereby disturbing the calibration, which will result in poor fuel economy and engine performance.

Final Check

If an engine has been properly overhauled with all parts fitted to specified clearances and assembled properly and **all parts thoroughly cleaned,** its performance and life will be increased materially.

See that engine is free, start it, and let run at a fast idle of 1000-1200 r.p.m. for a period of at least 30-minutes. Tighten cylinder head and readjust valve clearance after engine is warmed up. During the break-in period it is recommended that a good quality light oil (SAE-10 or 20) be used, care being taken to inspect oil level frequently and to maintain it at proper height.

An engine reconditioning job, as well as any other unit reconditioning, should certainly warrant its being carefully repainted prior to returning to a customer. The value of the impression thus created is inestimable and far-reaching.

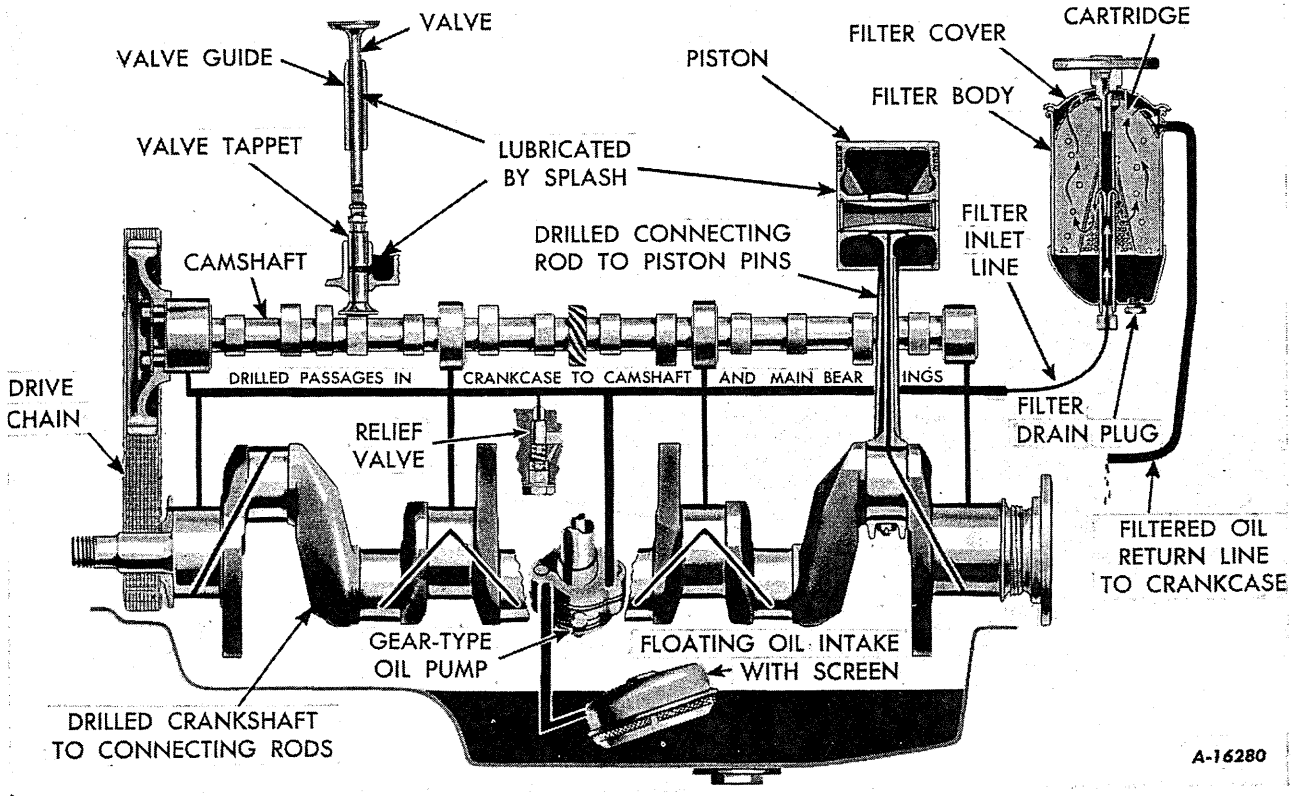

Fig. 25, GRD-Engine Lubrication System