FWD

TRUCK AND ENGINE MODEL INDEX—*Continued from page 555*

Truck Model	Year	Engine Used	Engine Model	Cooling Capacity, Qts.
SSU	1936-38	Waukesha	6SRL	*
SSUA	1936-38	Waukesha	6SRL	*
SU	1937-38	Waukesha	6SRL	32
SU	1939-43	Waukesha	6SRLR	32
SU	1946-52	Waukesha	6SRKR	36
SUA	1937-38	Waukesha	6SRL	24
SUA	1939-43	Waukesha	6SRLR	26
T26	1936-39	Waukesha	6BK	11
T26	1940-43	Waukesha	6BZ	11
T32	1937-38	Waukesha	6-110	14
T32	1939-43	Waukesha	6MKR	14
T40	1936-38	Waukesha	6-125	*
T40	1939-42	Waukesha	6SRKR	26
T45	1941-43	Waukesha	6RB	*
T60	1937-38	Waukesha	6RB	*
T60	1939-42	Waukesha	6RBR	*
T65	1937-38	Waukesha	6RB	*
T65	1939-42	Waukesha	6RBR	*
T72	1936-42	Hercules	HXE	*
X6	1936-38	Waukesha	6-125	*
YU	1937-38	Waukesha	6SRK	36
YU	1939-46	Waukesha	6SRKR	36
YU	1947-52	Waukesha	140GK	46
ZU	1950-52	Waukesha	140GZ	46

*Capacity not obtainable. Suggest it be measured.

GMC

INDEX OF SERVICE OPERATIONS

TRUCK AND ENGINE MODEL INDEX and COOLING SYSTEM CAPACITY

WARNING:—Be sure to check name plate on engine.

Truck Model	Year	Engine Used	Engine Model	Cooling Capacity, Qts.
100-22	1951-52	Own	228	17
101-22	1951-52	Own	228	17
150-22	1951-52	Own	228	18
152-22	1951-52	Own	228	18
250-22	1951-52	Own	228	18
280-22	1951-52	Own	228	18
300-24	1951-52	Own	248	18
350-24	1951-52	Own	248	18
F350-24	1951-52	Own	248	18
450-30	1952	Own	302	
F450-30	1952	Own	302	
W450-30	1952	Own	302	
470-30	1952	Own	302	
F470-30	1952	Own	302	
620-36	1952	Own	360	25
W620-42	1952	Own	426	27
630-42	1952	Own	426	27
W630-50	1952	Own	503	27
740-50	1952	Own	503	27
750-50	1952	Own	503	27
F750-50	1952	Own	503	27
850-50	1952	Own	503	27
W850-50	1952	Own	503	27
AC-100	1939-40	Own	228	15
AC-150	1939-40	Own	228	16
AC-250	1939-40	Own	228	16
AC-300	1939-40	Own	228	17
AC-350	1939-40	Own	228	17
AC-400	1939-40	Own	248	18
AC-450	1939-40	Own	248	18
AC-500	1939-42	Own	278	18
AC-520	1940-49	Own	308	18
AC-550	1939-42	Own	278	18
AC-600	1939-49	Own	308	18
AC-620	1945-49	Own	361	18
AC-650	1939-49	Own	308	18
AC-700	1939-49	Own	361	22
AC-720	1939-49	Own	426	22
AC-750	1940-49	Own	477	22
AC-770	1946-49	Own	361	22
AC-800	1939-49	Own	426	22
AC-850	1941-49	Own	477	22
AC-870	1939-49	Own	426	22
AC-890	1939-42	Own	451	22
AC-890	1946-49	Own	477	22
ACBX-305	1939-40	Own	228	17
ACK-100	1939-40	Own	228	15
ACK-350	1940	Own	228	17
ACKW-350	1940	Own	228	17
ACR-520	1940-49	Own	308	18
ACR-620	1940-49	Own	361	22
ACR-720	1939-49	Own	426	22
ACR-720	1946	Own	361	22
ACR-750	1940	Own	451	22
ACR-750	1940-49	Own	477	22
ACR-870	1939-42	Own	426	22
ACS-300	1939-40	Own	228	17
ACS-350	1939-40	Own	228	17
ACS-400	1939-40	Own	248	18
ACS-450	1939-40	Own	248	18
ACS-500	1939-42	Own	278	18
ACS-520	1946-49	Own	308	18
ACT-500	1939-42	Own	278	18
ACT-600	1939-42	Own	308	18
ACT-700	1939-49	Own	361	22
ACT-800	1941-42	Own	477	22
ACV-100	1940	Own	228	15
ACW-600	1939-42	Own	308	18
ACW-700	1939-42	Own	361	22
ACW-720	1939-42	Own	426	22
ACW-850	1941-42	Own	477	22
ACX-720	1945	Own	426	22
ACX-870	1939-48	Own	426	22
ACX-890	1939-42	Own	451	22
ACX-890	1946-48	Own	477	22
AF-230	1939-40	Own	230	16
AF-240	1939-41	Own	228	16
AF-300	1939	Own	228	17
AF-310	1939-40	Own	228	17
AF-350	1939-40	Own	228	17
AF-360	1939-40	Own	228	17
AF-400	1939-40	Own	248	18
AF-410	1939-40	Own	248	18
AF-450	1939-40	Own	248	18
AF-460	1939-40	Own	248	18
AF-500	1939-46	Own	278	18
AF-520	1946-49	Own	308	18
AF-550	1939-42	Own	278	18
AF-600	1939-49	Own	308	18
AF-620	1940-49	Own	361	18
AF-650	1939-49	Own	308	18
AF-700	1939-49	Own	361	22
AF-720	1939-49	Own	426	22
AF-750	1941-42	Own	451	22
AF-750	1941-49	Own	477	22
AF-750	1942	Own	426	22
AF-800	1939-49	Own	426	22
AF-800	1939-41	Own	451	22
AF-800	1940-42	Own	477	22
AF-850	1939-41	Own	426	22
AF-850	1939-41	Own	451	22
AF-850	1941-49	Own	477	22
AF-870	1939-40	Own	426	22
AF-870	1939-42	Own	451	22
AFNX-870	1939-40	Own	426	22
AFNX-870	1939-42	Own	451	22
AFP-240	1940-41	Own	228	16
AFR-520	1940-49	Own	308	18
AFR-620	1940-49	Own	361	22
AFR-720	1939-49	Own	426	22
AFR-750	1941-42	Own	451	22
AFR-750	1942	Own	426	22
AFR-750	1946-49	Own	477	22
AFR-850	1939-41	Own	426	22
AFR-850	1939-41	Own	451	22
AFR-850	1941-42	Own	477	22
AFRX-870	1939-42	Own	426	22
AFRX-870	1939-42	Own	451	22
AFT-700	1939-49	Own	361	22
AFW-410	1939-40	Own	248	18
AFX-240	1940	Own	228	16
AY-700	1940-41	Own	361	22
AY-800	1940-41	Own	426	22
AY-800	1940-42	Own	451	22
AY-850	1940-42	Own	451	22
AY-850	1941-42	Own	477	22
CC-100	1941-46	Own	228	16
CC-150	1941-42	Own	228	16
CC-250	1941-42	Own	228	16
CC-300	1941-42	Own	228	17
CC-300	1944-46	Own	236	17
CC-350	1941-42	Own	228	17
CC-400	1941-46	Own	248	18
CC-450	1941-42	Own	248	18
CC-450	1944-46	Own	270	18
CCS-305	1946	Own	236	17
CCS-350	1941-42	Own	228	17
CCS-400	1941-42	Own	248	18
CCS-450	1941-42	Own	248	18
CCT-350	1941	Own	228	17
CCT-400	1941-42	Own	248	18
CCV-100	1941-42	Own	228	15
CCW-350	1941	Own	228	17
CCW-400	1941-42	Own	248	18

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TRUCK AND ENGINE MODEL INDEX—*Continued from Page 557*

WARNING:—Be sure to check name plate on engine.

Truck Model	Year	Engine Used	Engine Model	Cooling Capacity, Qts.
CCX-450	1944-46	Own	270	18
CF-300	1941-42	Own	228	17
CF-350	1941-42	Own	236	17
CF-400	1941-42	Own	248	18
CF-450	1941-42	Own	248	18
EC-100	1946	Own	228	16
EC-150	1946	Own	228	16
EC-250	1946	Own	228	16
EC-280	1946	Own	228	16
EC-300	1946	Own	236	17
EC-350	1946	Own	248	18
EC-400	1946	Own	248	18
EC-450	1946	Own	270	18
EC-470	1946	Own	270	18
ECS-300	1946	Own	236	17
ECS-370	1946	Own	248	18
ECS-450	1946	Own	270	18
EF-240	1946	Own	228	16
EF-300	1946	Own	236	17
EF-350	1946	Own	248	18
EF-400	1946	Own	248	18
EF-450	1946	Own	270	18
EF-470	1946	Own	270	18
EFP-240	1946	Own	228	16
F16	1937-38	Own	230	17
F16BLH	1937	Own	230	17
F16BRH	1937	Own	230	17
F16CLH	1937	Own	230	17
F16CRH	1937	Own	230	17
F16H	1937-38	Own	230	17
F18	1937-38	Own	239	16
F18H	1937-38	Own	239	16
F23	1937-38	Own	257	17
F23H	1937-38	Own	257	17
F33	1937-38	Own	286	17
F33H	1937-38	Own	286	17
F46	1937-38	Own	331	26
F46	1937-38	Own	400	26
F61	1937-38	Own	400	28
F61	1937-38	Own	450	28
F61H	1937-38	Own	400	28
F61H	1937-38	Own	450	28
F61HX	1937-38	Own	400	28
F61HXX	1937-38	Own	450	28
F79	1937-38	Own	450	28
FC-100	1947-50	Own	228	17
FC-150	1947-50	Own	228	18
FC-250	1947-50	Own	228	18
FC-280	1947-50	Own	228	18
FC-300	1947-50	Own	248	18
FC-350	1947-50	Own	248	18
FC-450	1947-50	Own	270	18
FCS-300	1947-50	Own	248	18
FCS-370	1947-50	Own	248	18
FCS-450	1947-50	Own	270	18
FF-350	1947-51	Own	248	18
FF-450	1947-49	Own	248	18
FF-450	1950	Own	270	18
FFR-350	1947-50	Own	248	18
FFR-451	1950	Own	270	18
FH16CLH	1937	Own	230	17
FH16CRH	1937	Own	230	17
FP-150	1950	Own	228	18
HC-450	1950-51	Own	270	18
HC-470	1950-51	Own	270	18
HC-520	1950-51	Own	318	25
HC-600	1950-51	Own	318	25
HC-620	1950-51	Own	360	25
HC-640	1950-51	Own	426	27
HC-650	1950-51	Own	318	25
HC-700	1950-51	Own	360	25
HC-720	1950-51	Own	426	27
HC-740	1950-51	Own	503	27
HC-750	1950-51	Own	503	27
HC-770	1950-51	Own	360	25
HC-850	1950-51	Own	503	27
HC-870	1950-51	Own	426	27
HC-890	1950-51	Own	503	27
HCR-520	1950-51	Own	318	25
HCR-620	1950-51	Own	360	25
HCR-640	1950-51	Own	426	27
HCR-720	1950-51	Own	426	27
HCR-740	1950-51	Own	503	27
HCR-750	1950-51	Own	503	27
HCS-450	1950-51	Own	270	18
HCS-520	1950-51	Own	318	25
HCW-400	1950-51	Own	248	18
HCW-400	1950-51	Own	270	18
HCW-620	1950-51	Own	360	25
HCW-720	1950-51	Own	426	27
HCW-850	1950-51	Own	503	27
HF-450	1950-51	Own	270	18
HF-470	1950-51	Own	270	18
HF-520	1950-51	Own	318	25
HF-600	1950-51	Own	318	25
HF-620	1950-51	Own	360	25
HF-640	1950-51	Own	426	27
HF-650	1950-51	Own	318	25
HF-700	1950-51	Own	360	25
HF-720	1950-51	Own	426	27
HF-740	1950-51	Own	503	27
HF-750	1950-51	Own	503	27
HF-850	1950-51	Own	503	27
HFR-450	1950-51	Own	270	18
HFR-520	1950-51	Own	318	25
HFR-620	1950-51	Own	360	25
HFR-640	1950-51	Own	426	27
HFR-720	1950-51	Own	426	27
HFR-740	1950-51	Own	503	27
HFR-750	1950-51	Own	503	27
HFW-720	1950-51	Own	426	27
T14	1936	Own	213	15
T14	1937	Own	239	15
T14	1938	Own	223	15
T14ALH	1937	Own	230	15
T14ARH	1937	Own	230	15
T14BLH	1937	Own	230	15
T14BRH	1937	Own	230	15
T15	1938	Own	223	15
T16	1936	Own	213	17
T16	1937-38	Own	230	17
T16ALH	1937	Own	230	17
T16ARH	1937	Own	230	17
T16BLH	1937	Own	230	17
T16BRH	1937	Own	230	17
T16H	1936	Own	213	17
T16H	1937-38	Own	230	17
T18	1936-38	Own	239	16
T18H	1936-38	Own	239	16
T23	1936-38	Own	257	17
T23H	1936-38	Own	257	17
T33	1936-38	Own	286	17
T33H	1936-38	Own	286	17
T46	1936-38	Own	331	26
T46	1937-38	Own	400	26
T61	1936-38	Own	400	28
T61	1937-38	Own	450	28
T61H	1936-38	Own	400	28
T61H	1937-38	Own	450	28
T145	1938	Own	223	15
T155	1938	Own	223	16

MAJOR ENGINE SPECIFICATIONS

Engine Series	Number of Cylinders	Valve Arrangement	Bore	Stroke	Piston Displacement, Cubic Inches	Standard Compression Ratio	Maximum Torque Lbs. Ft. @ R. P. M.	Maximum Brake Horsepower @ Specified R. P. M.	Oil Capacity, Quarts
213	Six	L Head	3 5/16	4 1/8	213	6.00	152 @ 1200	84 @ 3500	6
223	Six	L Head	3 7/16	4	223	6.20	163 @ 1200	81 @ 3400	6
228	Six	Overhead	3 1/16	3 13/16	228	6.75	183 @ 1000	95 @ 3200	8
230	Six	L Head	3 7/16	4 1/8	230	6.10	172 @ 1200	86 @ 3500	6
236	Six	Overhead	3 5/8	3 13/16	236	6.75	187 @ 1000	97 @ 3200	8
239	Six	Overhead	3 5/16	4 5/8	239	5.10	175 @ 800	81 @ 3000	7
248	Six	Overhead	3 23/32	3 13/16	248	6.75	202 @ 1000	100 @ 3100	8
257	Six	Overhead	3 7/16	4 5/8	257	5.00	190 @ 800	88 @ 2800	7
270	Six	Overhead	3 25/32	4	270	6.75	222 @ 1000	104 @ 3000	10½
278	Six	Overhead	3 5/8	4½	278	6.00	230 @ 1000	110 @ 3000	9
286	Six	Overhead	3 5/8	4 5/8	286	4.90	205 @ 1000	90 @ 2600	7
302	Six	Overhead	4	4	302	7.20	262 @ 1200	145 @ 3600	10½
308	Six	Overhead	3 13/16	4½	308	6.00	241 @ 1000	122 @ 3200	9
318	Six	Overhead	3 7/8	4½	318	6.50	245 @ 1400	136 @ 3400	12½
331	Six	Overhead	3¾	5	331	4.74	230 @ 800	94 @ 2500	12
360	Six	Overhead	4 1/8	4½	360	6.50	289 @ 1300	127 @ 3000	12½
361	Six	Overhead	4 1/8	4½	361	6.00	273 @ 1000	136 @ 3000	11
400	Six	Overhead	4 1/8	5	400	4.75	296 @ 800	110 @ 2300	12
426[1]	Six	Overhead	4¼	5	426	6.00	345 @ 1000	145 @ 2600	12½
426[2]	Six	Overhead	4¼	5	426	6.50	337 @ 1200	177 @ 3200	12½
450	Six	Overhead	4 3/8	5	450	4.73	350 @ 800	150 @ 2500	12
451	Six	Overhead	4 3/8	5	451	6.00	350 @ 1000	146 @ 2400	11
477	Six	Overhead	4½	5	477	6.00	385 @ 1000	154 @ 2600	11
503	Six	Overhead	4 9/16	5 1/8	503	6.50	415 @ 1200	190 @ 3000	12½

[1] Up to and including 1949 production.
[2] Starting with 1950 production.

TUNE UP & VALVE DATA

Ignition Timing—See page 567.

Engine Series	Firing Order	Spark Plug Gap, Inch	Breaker Gap, Inch	Valve Seat Angle, Degrees	Valve Clearance H—Hot C—Cold		Valve Stem Clearance		Average Valve Spring Pressure Lbs. @ Inches Length
					Intake	Exhaust	Intake	Exhaust	
213	153624	.025	.020	[1]	.008 H	.010 H	.001-.003	.002-.004	116 @ 2
223	153624	.025	.020	[1]	.012 H	.012 H	Free	Free	96 @ 1 5/8
228	153624	[2]	.020	30	[3]	[3]	.0015-.003	.002-.004	132 @ 1½
230	153624	.030	.020	30	.008 H	.011 H	.001-.003	.0025-.0045	95 @ 1 11/16
236	153624	.030	.020	30	.012 H	[7]	.0015-.003	.002-.004	132 @ 1½
239	142635	.025	.020	45	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
248	153624	[2]	.020	30	[3]	[3]	.0015-.003	.002-.004	132 @ 1½
257	142635	.025	.020	45	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
270	153624	.030	.020	30	.012 H	[8]	.0015-.003	.002-.004	132 @ 1½
278	142635	[2]	.020	30	.012 H	.016 H	.0015-.003	.002-.004	121 @ 1 41/64
286	142635	.025	.020	45	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
302	153624	.030	.020	30	.012H	.020H	.0015-.003	.002-.004	132 @ 1½
308	142635	[2]	.020	45	.012 H	.016 H	.0015-.003	.0025-.004	121 @ 1 41/64
318	142635	.030	.020	45	.012 H	.018 H	.0015-.003	.002-.0035	151 @ 1 13/32
331	142635	.035	.020	45	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
360	142635	.030	.020	45	.012 H	.018 H	.0015-.003	.002-.0035	151 @ 1 13/32
361	142635	[2]	.020	[1]	[3]	[3]	.0015-.003	.0025-.004	121 @ 1 41/64
400	142635	.035	.020	30	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
426[5]	142635	[2]	.020	[1]	[3]	[3]	.0015-.003	.0025-.004	121 @ 1 41/64
426[6]	142635	.030	.020	45	.012 H	.018 H	.0015-.003	.0025-.004	166 @ 1 21/64
450	142635	.035	.020	30	.013 H	.013 H	.0015-.0035	.0035-.0055	[4]
451	142635	.025	.020	[1]	.012 H	.012 H	.0015-.003	.0025-.004	121 @ 1 41/64
477	142635	.030	.020	[1]	.012 H	.016 H	.0015-.003	.0025-.004	121 @ 1 41/64
503	142635	.030	.020	45	.012 H	.018 H	.0015-.003	.0025-.004	166 @ 1 21/64

[1] Intake 30, exhaust 45.
[2] Before 1946 .025"; after .030".
[3] Before 1946 intake .006", exhaust .013"; after 1945 intake .012", exhaust .016". Starting with engine number 149,320, exhaust .020".
[4] Outer spring 64 @ 1 1/32; inner 35 @ 1 3/16.
[5] Up to and including 1949 production.
[6] Starting 1950 production.
[7] Before engine number 40537 .016"; starting with engine number 40537, .020".
[8] Before engine number 740431 .016"; starting with engine number 740431 .020". The .020" specification also applies to engine numbers 729072 and 720087 to 720200.

PISTONS, RINGS & BEARINGS

Engine Series	Pistons Remove From	Piston Clearance, Inch	Ring End Gap, Inch (Minimum)		Crankpin Diameter, Inches	Rod Bearing Clearance, Inch	Main Bearing Journal Diameter, Inches	Main Bearing Clearance, Inch	Crankshaft End Play, Inch
			Compression	Oil					
213	Above	.0015	.007	.007	1.998-1.999	.001-.003	[1]	.001-.003	.004-.008
223	Above	.002	.007	.007	1.998-1.999	.0005-.0015	[2]	.001-.003	.003-.008
228	Above	.003	.009	.009	2.311-2.312	.0006-.0026	[3]	.0008-.0033	.003-.008
230	Above	.0015	.009	.009	2.123-2.124	.0005-.002	[4]	.001-.003	.004-.008
236	Above	.003	.009	.009	2.311-2.312	.0006-.0026	[3]	.0008-.0033	.003-.008
239	Above	.003	.011	.011	2.123-2.124	.0015-.002	2.373-2.374	.0015-.002	.003-.007
248	Above	.003	.009	.009	2.311-2.312	.0006-.0026	[3]	.0008-.0033	.003-.008
257	Above	.003	.011	.011	2.123-2.124	.0015-.002	2.373-2.374	.0015-.002	.003-.007
270	Above	.00325	.008	.008	2.311-2.312	.0006-.0026	[3]	.0008-.0033	.003-.008
278	Above	.003	.009	.010	2.374-2.375	.001-.004	2.749-2.750	.001-.003	.003-.008
286	Above	.003	.011	.011	2.123-2.124	.0015-.002	2.373-2.374	.0015-.002	.003-.007
302	Above	.00325	.008	.008	2.311-2.312	.0006-.0026	[3]	.0008-.0033	.003-.008
308	Above	.003	.010	.010	2.374-2.375	.0015-.0025	2.749-2.750	.0015-.0025	.003-.008
318	Above	.0032	.013[5]	.011	2.374-2.375	.0022-.0037	2.749-2.750	.001-.003	.003-.008
331	Below	.003	.012	.012	2.372-2.373	.0025-.003	2.495-2.505	.0015-.002	.003-.007
360	Above	.0035	.014[5]	.012	2.374-2.375	.0022-.0037	2.749-2.750	.001-.003	.003-.008
361	Above	.003	.011	.011	2.624-2.625	.0015-.0025	2.999-3.000	.0015-.0025	.003-.008
400	Above	.003	.012	.012	2.624-2.625	.0025-.003	2.7075-2.7085	.0015-.002	.003-.007
426[6]	Above	.0032	.012	.012	2.624-2.625	.001-.003	2.999-3.000	.001-.003	.004-.008
426[7]	Above	.0037	.015[5]	.013	2.624-2.625	.0022-.0037	2.999-3.000	.001-.003	.003-.008
450	Above	.003	.012	.012	2.624-2.625	.0025-.003	2.7075-2.7085	.0015-.002	.003-.007
451	Above	.0032	.018	.015	2.624-2.625	.0025-.0035	2.999-3.000	.0015-.0025	.004-.008
477	Above	.0034	.013	.013	2.624-2.625	.0025-.0035	2.999-3.000	.0015-.0025	.004-.008
503	Above	.0042	.016[5]	.014	2.624-2.625	.0022-.0037	2.999-3.000	.001-.003	.003-.008

[1] No. 1: 2.478-2.479
No. 2: 2.5405-2.5415
No. 3: 2.6655-2.6665
No. 4: 2.728-2.729

[2] No. 1: 2.3725-2.3735
No. 2: 2.4037-2.4047
No. 3: 2.4662-2.4672
No. 4: 2.4975-2.4985

[3] No. 1: 2.6835-2.6845
No. 2: 2.7145-2.7155
No. 3: 2.7455-2.7465
No. 4: 2.7765-2.7775

[4] No. 1: 2.478-2.479
No. 2: 2.5405-2.5415
No. 3: 2.6655-2.6665
No. 4: 2.6855-2.6865

[5] Specification is for top ring only; for second and third ring use specifications in oil ring column.
[6] Up to and including 1949 production.
[7] Starting with 1950 production.

ENGINE

CYLINDER HEAD

ALL ENGINES—Cylinder heads should be tightened down by starting from the center, working outward from side to side and to the ends. Draw the nuts or bolts down evenly, repeating the operation until all are normally tight. After the engine has been run long enough to warm it up, a final tightening should be made with a torque wrench in the order shown in the illustrations and to the torque values given below.

Engine Series	Lbs. Ft.
213, 223	60-70
228	70-80
230, 236, 239	60-70
248, 256	70-80
257	60-70
270	70-80
278	65-75
286	60-70
302	90-100
308, 331	65-75
318, 360, 361	75-85
400	65-75
426	75-85
450	65-75
451, 477, 503	75-85

On all overhead valve engines, be sure to check valve clearances after the final tightening.

EXHAUST VALVE ROTATOR

1950-52 ENGINES 318, 360, 426, 503—Valves equipped with rotators depend upon clearance between end of valve stem and cap for freedom to rotate. Clearance must be from .002 to .004" and must be maintained to insure proper valve operation, maximum valve life and efficiency.

Whenever valve work is done check the clearance and if it is less than .002", grind off the end of the valve stem. If the clearance is more than .004", grind off the open end of the valve cap.

VALVE SEAT INSERTS

ALL ENGINES—Whenever a valve grind job is being done, check the exhaust valve seat inserts. If one is found to be loose or cracked, it should be removed with a puller and its recess carefully cleaned before installing the new seat. (Screw type inserts are used in 331, 400 and 451 engines.)

On engines with the pressed-in type inserts, shrink the insert by packing it in dry ice for about an hour before driving it in place.

ROCKER ARMS

OVERHEAD VALVE ENGINES—When disassembling rocker arms, place all parts on the work bench in their proper relationship to assure correct assembly.

Before reassembling, check the rocker arms to be sure the ball ends are not pitted or rough. If used in this condition, it will be difficult to maintain proper valve clearances.

VALVE GUIDES

ALL ENGINES—If an inspection shows that the valve guides are worn .001" more than the maximum allowable clearance, they should be replaced.

Before removing the old guides, be sure to measure the distance between the top of the old guide and the top of the block (or head) in order to be certain that the new guides are installed correctly. Measurements should be taken of one intake and one exhaust guide. If the correct dimensions are not maintained, interference between the valve spring retainers and the ends of the valve guides may result.

After the new guides have been installed, they should be reamed to provide the proper operating clearance.

NOTE—Guides in 223 series engines are tapered with the upper end slightly larger than the lower end. A suitable taper reamer should be used to fit the valve stems in the guides. The guides taper .001" to the inch and when reamed properly, the valves should fall through the guides of their own weight. At the bot-

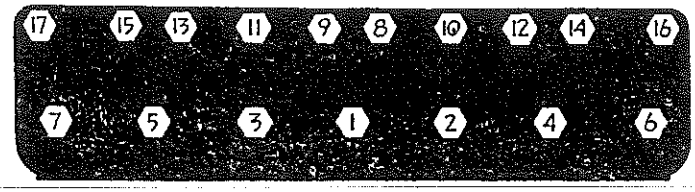

Fig. 1 Head tightening chart for 239, 257, 286, 331, 400 and 450 engines

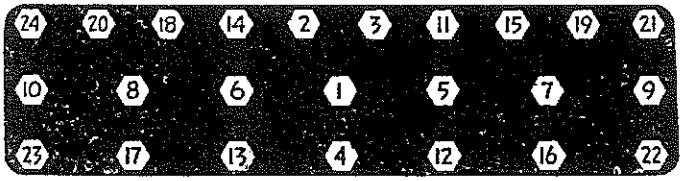

Fig. 2 Head tightening chart for 213 and 230 engines

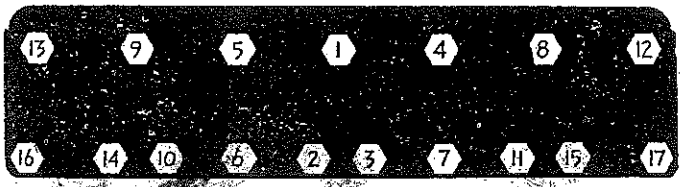

Fig. 3 Head tightening chart for 278 and 308 engines

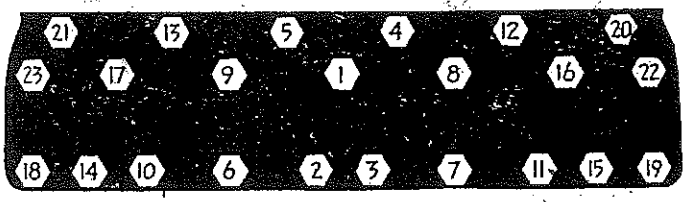

Fig. 4 Head tightening chart for 361, 426, 451 and 477 engines

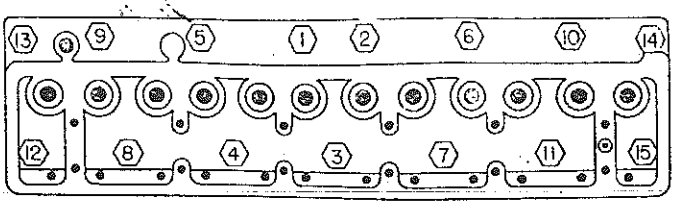

Fig. 5 Preliminary tightening sequence on 228, 236, 248, 256, 270, 302 engines

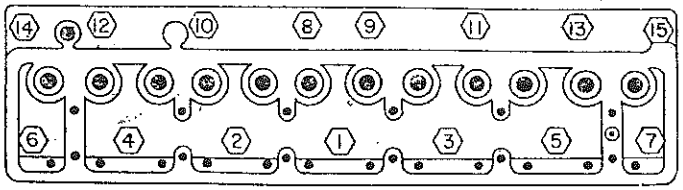

Fig. 5A Final tightening sequence on 228, 236, 248, 256, 270, 302 engines

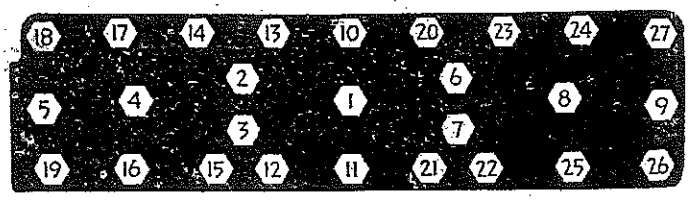

Fig. 6 Head tightening chart for 223 engine

tom of the guide, the maximum clearance should be from a free fit to .0006" loose.

VALVE LIFTERS

1939-52 ENGINES—Valve lifters are of the barrel type operating in guide holes bored in the cylinder block. Lifters must be a free fit in their guides without excessive side play. If the fit is too loose, guides should be reamed and oversize lifters fitted.

213, 223 ENGINES—Valve lifter guides in these engines are cast in the block and barrel type lifters are used. To remove lifters, it is necessary to remove the cylinder head and valves, taking the lifters out through the valve compartment.

230 ENGINE—Valve lifters are of the mushroom type operating in guide holes cast in the block. To remove guides, therefore, it is necessary to take out the camshaft and take the lifters out through the bottom of the engine.

239, 257, 286 ENGINES—Valve lifters in these engines operate in guides which are

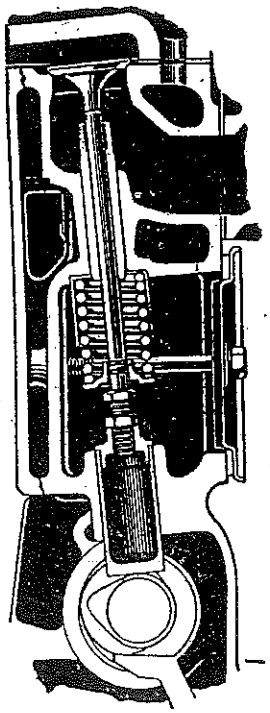

Fig. 7 Valve mechanism on 223 engine

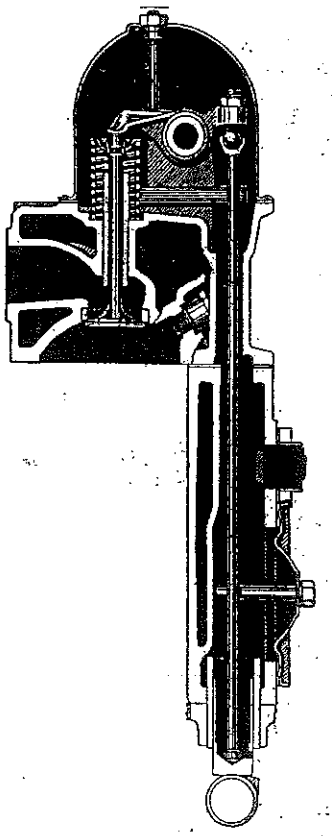

Fig. 9 Valve mechanism on 278 and 308 engines

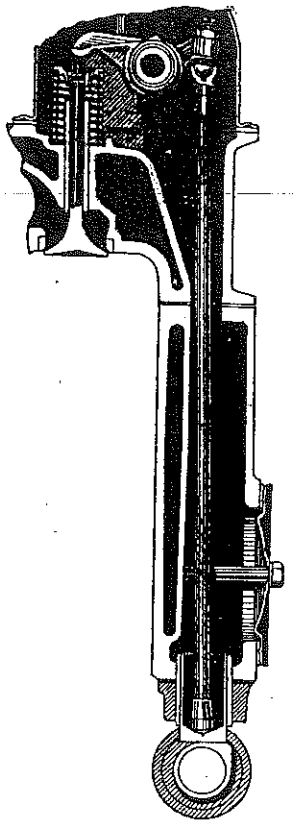

Fig. 10 Valve mechanism on 361, 426, 451 and 477 engines

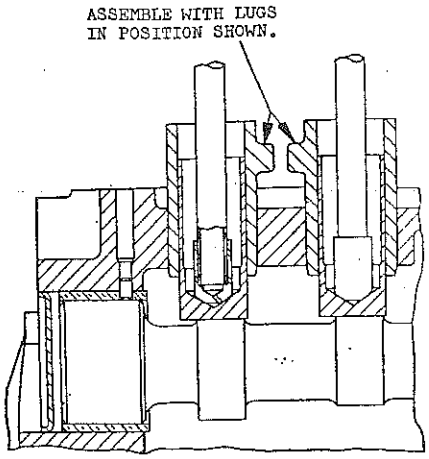

Fig. 11 Valve lifter guides on 239, 257 and 286 engines

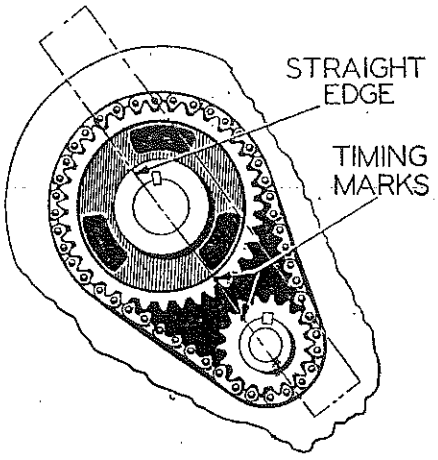

Fig. 12 Valve timing on 213, 223 and 230 engines

pressed into the block. When necessary to install new guides, be sure the lugs on each pair of guides are toward each other, as shown in Fig. 11.

331, 400, 450 ENGINES—Valve lifter and guide assemblies are equipped with compression springs retain d by spring caps. The assemblies are secured in sets of two by a clamp.

The roller pins are a pressed fit in the lifters and, after assembly, the roller should have about .002" side clearance to permit free movement.

VALVE TIMING

ALL ENGINES—If the timing gears are removed for any reason, the camshaft must be timed when the gears are replaced. Before removing gears, make sure the timing marks are legible. And when replaced, match the timing marks according to the data given in the illustrations.

If timing marks are not legible or if replacement gears do not have marks, be guided by the position of the keyways and number of teeth between them as shown in the illustrations for correct valve timing.

CAMSHAFT & BEARINGS

ALL ENGINES—On all engines except 213 and 230 series, camshaft end play is controlled by a thrust plate at the front end of the shaft behind the camshaft gear. End play should be held to about .005" and can be checked with a feeler gauge between the thrust plate and the hub of the gear. If clearance is excessive, install a new thrust plate.

On 213 and 230 engines, camshaft end play is controlled by a spring-loaded steel plunger in the front end of the shaft. The free length of this spring is 1-21/32" and when compressed to 1-11/32" a spring test should show a pressure of 23-27 pounds.

Camshaft bearings should be installed in sets and care must be exercised to see that the oil holes in the bearings and the oil feed holes in the block are aligned to assure adequate lubrication.

On 228, 236, 248, 256, 270 and 302 engines, it is important that the rear bearing be installed with the cut-out toward the rear of the block, otherwise the oil flow to this bearing will be restricted. And before reaming the bearings, insert a suitable round-nosed punch, Fig. 18, through the oil passage from the main bearings to the camshaft bearings and stake each bearing in place as shown.

To assure proper camshaft fit on 239, 257, 286, 331, 400 and 450 engines, bearings should be reamed *after* the cylinder block is bolted to the crankcase. The bearings in these engines are held in place by dowel pins, Fig. 19. Be sure to install the rear bearing with the cut-out portion to the rear and toward the inside, otherwise the oil flow to this bearing will be restricted. The drilled hole in the front bearing must be clean as oil is directed to the thrust plate through this hole.

On 278, 308, 361, 426, 451 and 477 engines, since the cylinder block bolts to the crankcase, be sure to fasten these parts together before reaming camshaft bearings to assure proper camshaft fit.

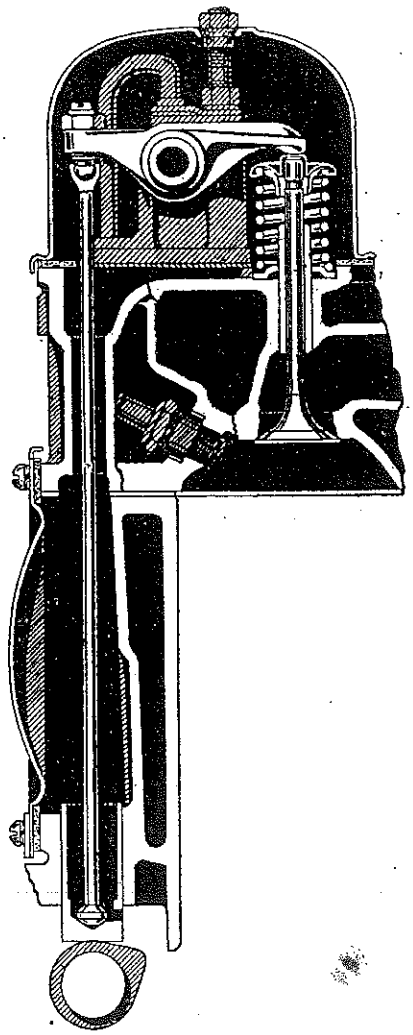

Fig. 8 Valve mechanism on 228, 236, 248, 256, 270 & 302 engines

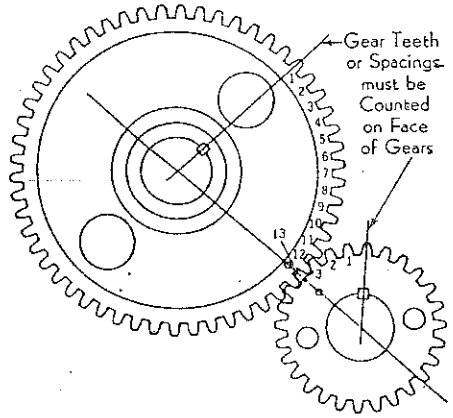

Fig. 13 Valve timing on 228, 236, 248, 256 and 270 engines

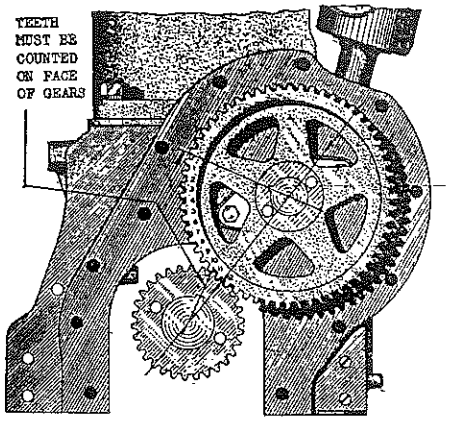

Fig. 14 Valve timing on 361, 426, 451 and 477 engines

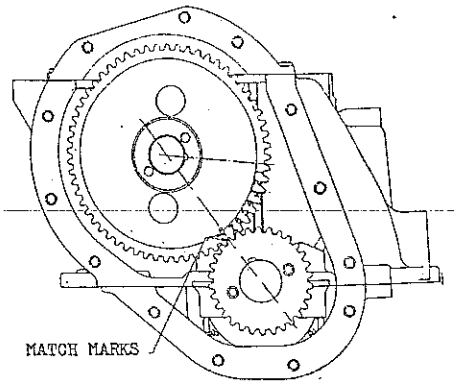

Fig. 15 Valve timing on 331, 400 and 450 engines

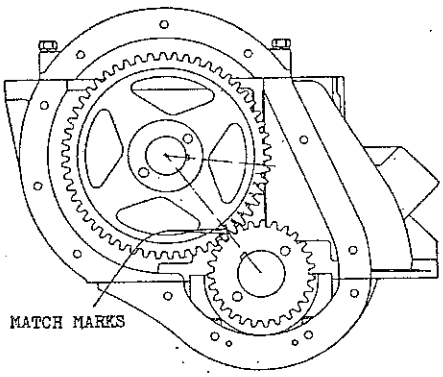

Fig. 16 Valve timing on 239, 257 and 286 engines

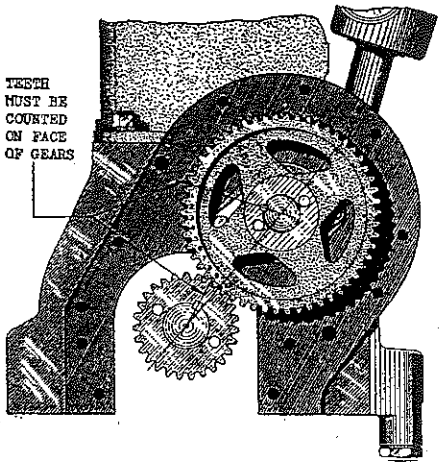

Fig. 17 Valve timing on 278 and 308 engines

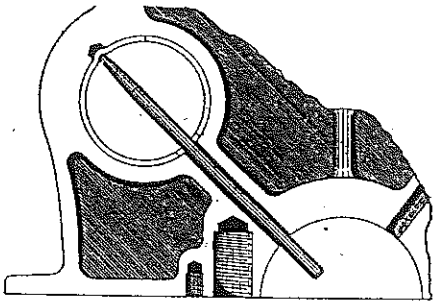

Fig. 18 Method of locking camshaft bearings with round-nosed punch on 228, 236, 248, 256 and 270 engines

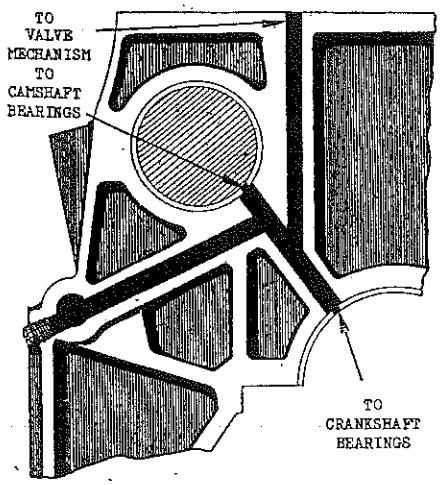

Fig. 21 Oil holes in bearings must line up with oil feed holes in crankcase on all engines. Illustration shows 278, 308, 361, 426, 451 and 477 engines

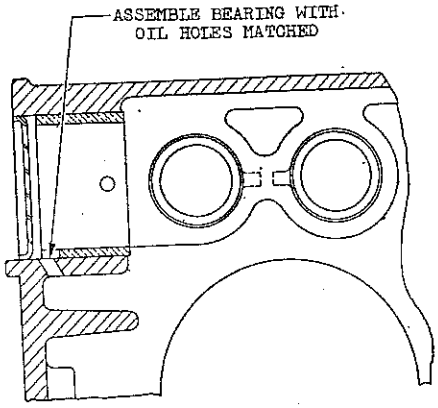

Fig. 20 Installing rear camshaft bearing on 239, 257, 286, 331, 400 and 450 engines

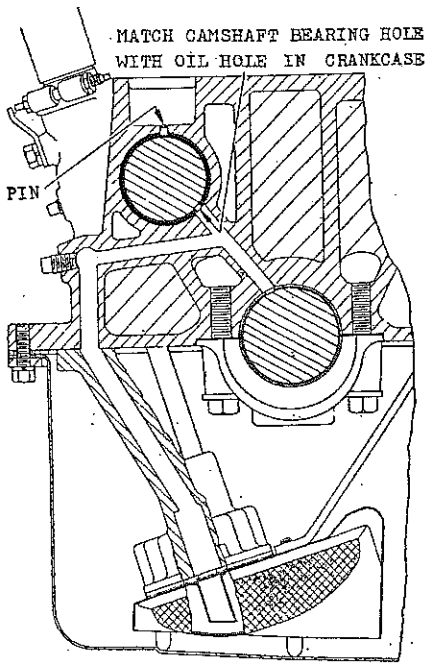

Fig. 19 Installing camshaft bearings on 239, 257, 286, 331, 400 and 450 engines

PISTONS

ALL ENGINES—When fitting a piston, wipe the cylinder wall clean with a cloth and insert the piston upside down in the bore (rings and pin removed). Use a ½" wide feeler which is long enough to extend the full length of the piston. The thickness of the feeler should be the same as the piston clearance given in the chart. With the feeler hooked to a spring scale, a pull of 4 to 8 pounds should be required to pull the feeler past the piston.

PISTON RINGS

ALL ENGINES—Always use standard size rings in cylinder bores that are standard at the bottom, regardless of the amount of taper in the bore. Oversizes must be determined by the measurement of the narrowest portion of the bore.

Before removing pistons, the ridge at the top of each cylinder should be cut away with a ridge reamer. This eliminates the danger of breaking ring lands which might result if the rings were driven past the ridges. To prevent the possibility of undercutting cylinder walls, don't try to remove the last traces of the ridge; this can be done afterward by honing.

New rings should be fitted according to the instructions furnished with the ring package. Ring grooves must be clean and free from carbon and must show no perceptible wear.

PISTON PINS

ALL ENGINES (Except 213, 223, 230)—Piston pins in these engines are of the floating type, being free to rotate in both the rod and piston bosses. Snap rings, located in grooves in the piston bosses, prevent the pins from rubbing against the cylinder walls.

To fit a pin in these pistons, heat the piston in a pail of boiling water for several minutes. Then remove the piston and quickly insert the pin.

When the snap ring keepers are installed in the piston grooves, it should not be possible to turn the rings with the fingers.

213, 230 ENGINES—Pins are a press fit in both piston bosses but the boss on the lock side is reamed approximately .0003" smaller than the opposite boss.

To remove the pin, heat the piston in boiling water for about a minute. Then remove the lock screw and press the pin out through the plain boss side.

To install, again heat the piston, then dip the pin in hot engine oil and start the pin through the plain boss and connecting rod, making sure that the lock screw holes in the pin and boss are in line. Press the pin all the way through and install the lock screw.

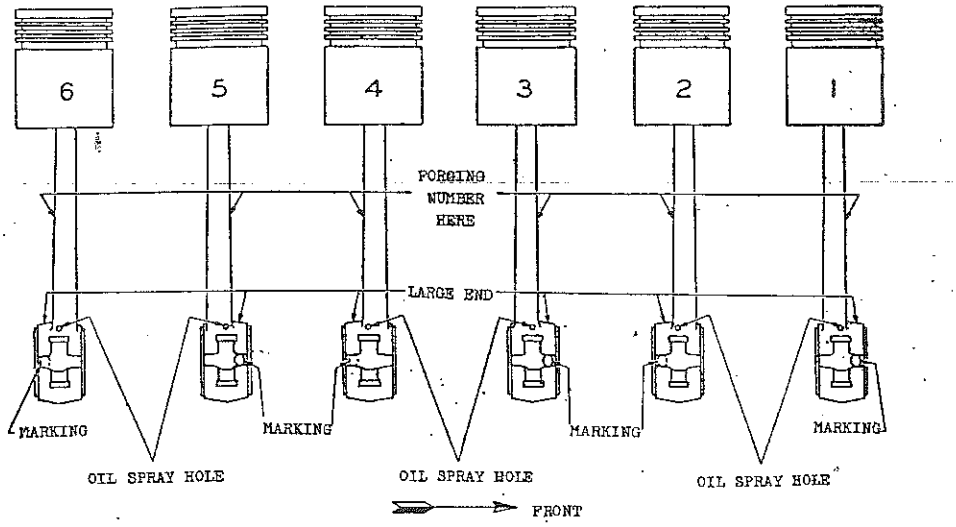

Fig. 22 Correct installation of rods on 239 and 257 engines

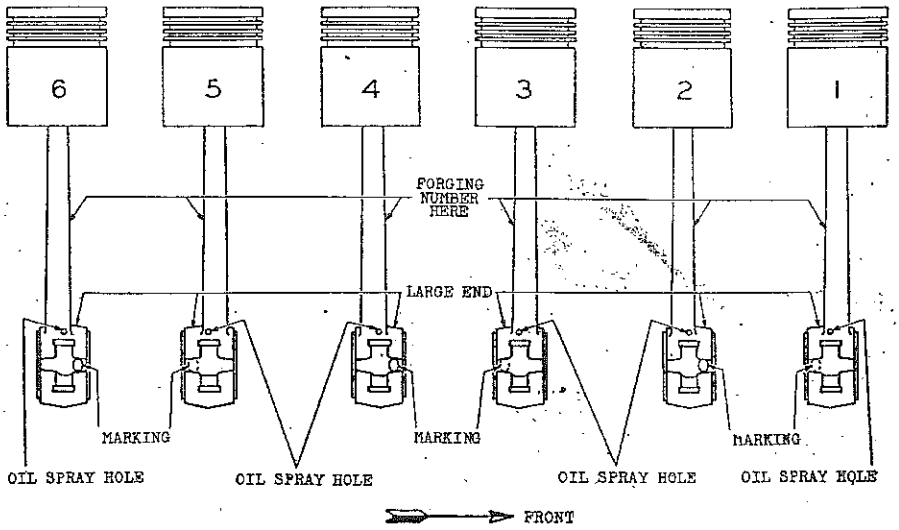

Fig. 23 Correct installation of rods on 286 engines

If heavy pressure is required to push the pin in the lock screw boss, it indicates that the piston has cooled slightly, in which case, remove the rod and again heat the piston.

223 ENGINES—When fitting pins, coat the inside of both piston bosses with graphite grease, then press the pin into the piston, entering the slotted end first into the lock boss.

PISTON PIN BUSHINGS

ALL ENGINES—New bushings should be pressed in the rod and broached or honed so that with all parts clean and dry and at normal room temperature, the pin will slide in the bushing with a slight push of the thumb.

On 223, 228, 236, 248, 256 and 270 engines, two bushings are used in each rod with a space provided between them for lubrication. All other engines (except 213) use one bushing in each rod and when installed, the oil hole in the bushing should be in line with the oil hole in the rod.

Bushings used in 213 engines are of the split type and when installed, should be bonded to the rod with a burnishing tool before reaming or broaching.

ROD BEARINGS

ALL ENGINES (Except 239, 257, 286, 331)—These bearings are of the precision insert type requiring no reaming or scraping. On some engines, these bearings are designed for use without shims and under no circumstances should shims be used in order to affect an adjustment because the proper "crush" fit of the bearings in the rods will not be obtained.

Other engines employ shims between

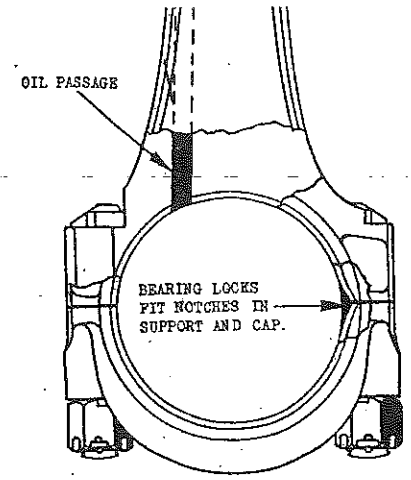

Fig. 24 Rod bearing details on all engines using insert type bearings

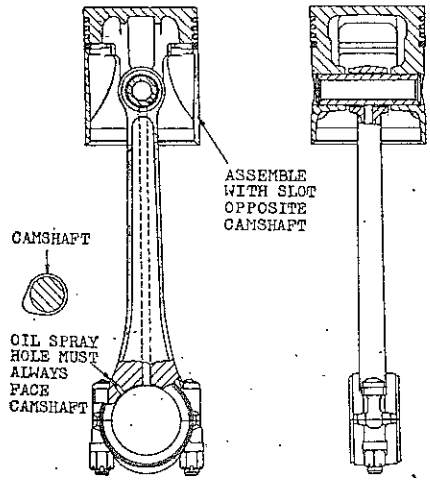

Fig. 25 Correct assembly of piston and rod on 239, 257, 286, 331, 400 and 450 engines

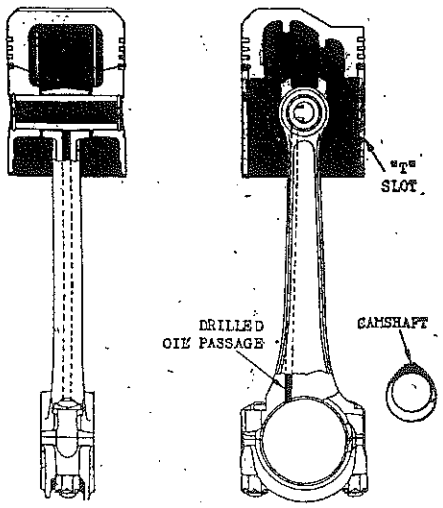

Fig. 26 Correct assembly of piston and rod on 278, 308, 361, 426, 451 and 477 engines

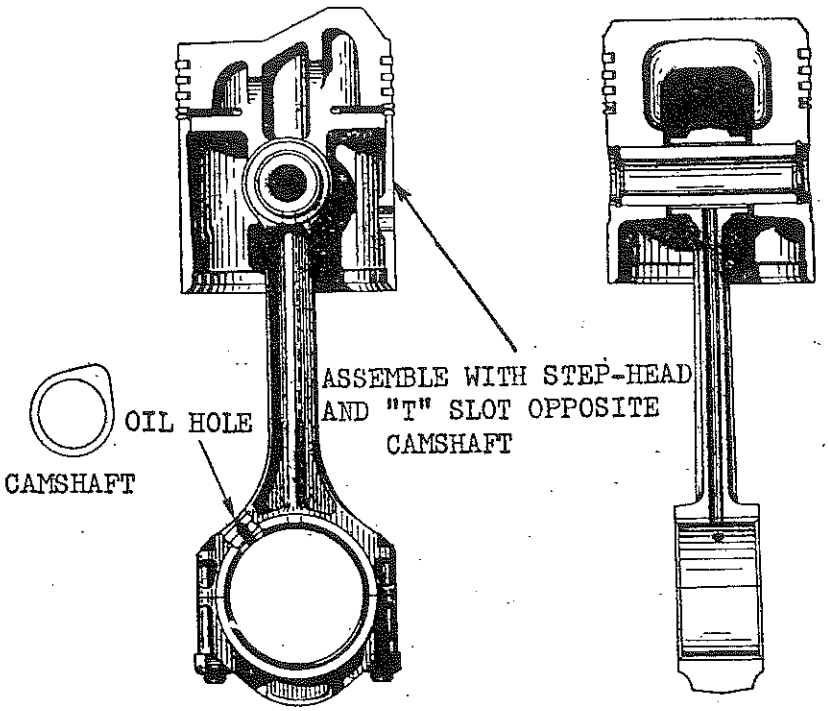

Fig. 27 Correct assembly of piston and rod on 213, 228, 230, 236, 248, 256 and 270 engines

the bearing cap and rod *only* on the side opposite the bearing lock notch. When shims are employed, never use more than the original thickness shim pack (.006") to obtain proper bearing fit.

When installing bearings, be sure the back of the bearing shells as well as the bearing seats in the rods are smooth, clean and dry.

Bearing clearance may be checked with Plastigage, which is available at any auto parts jobber. Instructions for its use are furnished with the package.

Lacking Plastigage, however, use a piece of tough paper or shim stock ¾" square which measures about .0005" under the maximum allowable bearing clearance. Oil the shim on both sides and lay it in the center of the bearing. Install the assembled bearing and cap and tighten the cap bolts to normal tension.

The clearance is correct if the rod can be moved endwise when tapped lightly with a hammer. If the rod can be moved endwise by hand, clearance is too great. On the other hand, if the rod will not move when tapped lightly with a hammer, not enough clearance is present.

NOTE—On engines using a shim pack on one side, clearance can be reduced, for example, by substituting a .002" shim for a .003" shim. Use any combination of these shims to obtain proper clearance.

239, 257, 286, 331 ENGINES—Rod bearings are the spun type and not replaceable. If bearings require adjustment, remove the same thickness of shims from each side until a metal-to-metal contact is established with the crankpin. The bearing may then be scraped to provide maximum bearing surface and sufficient shims installed on both sides to obtain proper clearance.

When using a torque wrench, tighten bearing caps to the following torque values:

Engine Series	Lbs. Ft.
213, 223, 228, 230, 236	40- 50
239	65- 75
248, 256	40- 50
257	65- 75
270, 302	40- 50
278, 286, 308, 318, 360	65- 75
331, 361, 400, 426, 450, 451, 477, 503	90-100

MAIN BEARINGS

ALL ENGINES (Except 331)—These bearings are of the insert type, requiring no scraping or reaming. They may be removed and replaced without removing the crankshaft.

Plastigage may be used to check bearing clearances, and instructions as to its use are furnished with the package.

Lacking Plastigage, an alternate method is to use a piece of tough paper or shim stock 1" square which measures about .001" under the maximum allowable bearing clearance. Oil the shim on both sides and lay it in the center of the bearing. Install the assembled bearing and cap and tighten cap bolts to normal tension.

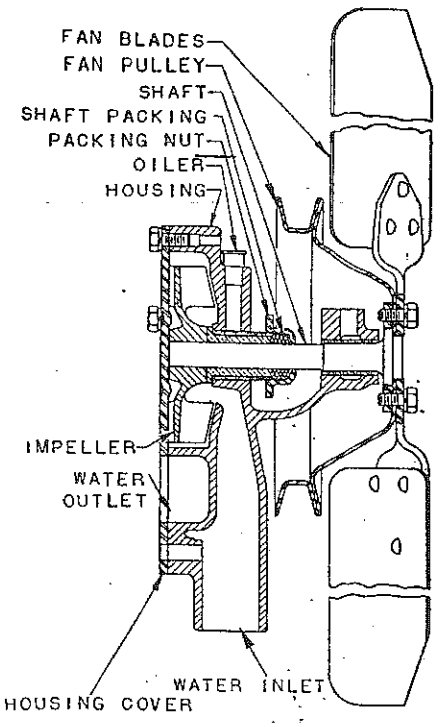

Fig. 28 Water pump on 213 engine

Rotate the crankshaft through a two-inch arc (one each way) and if it is movable with a fairly heavy drag, the clearance is correct. If there is no perceptible drag, the clearance is too great. On the other hand, if the shaft cannot be moved, not enough clearance is present.

Be sure that the bearings are smooth and clean on both sides when installed. This applies to the bearing seats as well.

NOTE—Early production 228 and 248 engines employed shims between the bearing cap and support *only* on the side opposite the bearing lock notch. Later production of these engines do not use any shims. Similarly, early 278, 308, 361, 426 and 451 engines used shims between the cap and support on *both* sides, which have been eliminated entirely on later production of these engines. In either case, whether shims are used on one or both sides, the shim pack should not exceed .006" on any one side, nor should these shims project between the edges of the bearings as this will cause the bearings to buckle when the bolts are tightened.

CAUTION—Never attempt to fit bearings by using shims on both sides if the bearing is designed for the use of shims on one side only. Nor should shims be eliminated from one side if the design calls for shims on both sides. Of course, if the bearing is designed for use without shims, do not attempt to obtain a bearing fit by their use.

When fitting bearings on engines using shims, two sizes are available: The .002" shim can be identified by a small hole near the bolt hole, whereas the .003" shim has no hole. Bearing clearance can be reduced. for example, by removing a .003" shim and putting in a .002" shim.

331 ENGINE—1936-37 engines of this series have bearings which are held in their supports and caps by dowel pins, and when new bearings are fitted, they should be line reamed to fit the crankshaft.

1938 engines of this series use bearings of the insert type with shims provided for adjustment on both sides.

NOTE—When using a torque wrench to tighten main bearing caps, tighten them to the following torque values:

Engine Series	Lbs. Ft.
213, 223, 230	75- 85
228, 236, 248, 256, 270, 302	70- 80
239, 257, 286, 331, 361	90-100
278, 308	75- 85
318, 360, 400, 426, 450, 451, 477, 503	90-100

CRANKSHAFT END THRUST

ALL ENGINES—On all engines except 213 and 230, crankshaft end thrust is controlled by flanges on the rear intermediate main bearing. Through normal wear end play will seldom become excessive (over .008") but whenever new bearings are fitted, check the end play by forcing the crankshaft back to the limit of its end play with a pry bar and check the clearance with a feeler gauge between the bearing flange and crankshaft cheek.

On 213 and 230 engines, end play is controlled by thrust washers located at the front end of the crankshaft. Too much end play can be eliminated by installing new washers.

OIL PUMP

ALL ENGINES—Conventional gear type oil pumps are used on all engines. After the removal of the oil pan, the pump is accessible for service.

Before removing the pump on 223, 278, 308, 361, 426, 451 and 477 engines, turn the engine over to bring No. 1 piston up to the firing position, noting the position of the distributor rotor. Do not disturb the distributor position while the pump is off the engine. Remove the pump attaching screws and dismount the pump.

Before installing the pump, see that the distributor is still in the No. 1 firing position. If it isn't, move it to this position and install the pump, maintaining the same position for the rotor. After the pump is installed, reset the ignition timing.

OIL PRESSURE REGULATOR

On engines 278, 308, 361, 426, 451 and 477, the oil pressure regulator is located in the oil filter base and is not adjustable.

On all other engines, a non-adjustable regulator is located in the oil pump base.

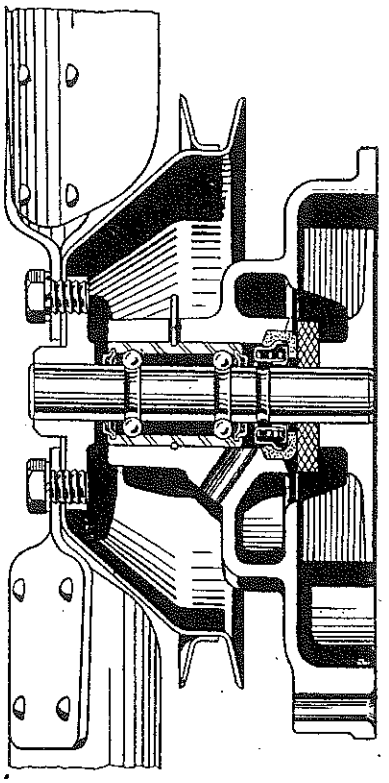

Fig. 29 Water pump on 223 engine. Typical of 230 engine

WATER PUMP

213 ENGINE—Fig. 28. If packing only is required, remove the pump and take off the fan. Disconnect the pump cover and press off the impeller. Install new packing, coating the bearing surface of both packing and shaft with engine oil. Tighten the packing nut a normal amount, rotate the shaft and retighten the nut. Run the engine until hot to allow the packing to seat properly, then make a final tightening of the nut.

Either bushing may be replaced without disturbing the other. When bushings are pressed in place, they should be burnished to provide a clearance of .0005" to .0022" between shaft and bushing.

End play of the shaft should be from .008" to .014". If not within these limits, remove the cover and change the position of the impeller.

223, 228, 230, 236, 248, 256, 270, 302—The pumps used on these engines, Figs. 29 and 30, are of the sealed ball bearing type packed with lubricant at the time of assembly and requiring no further lubrication. When disassembling, carefully note the arrangement of the seal parts so that correct assembly may be assured.

Never soak the shaft and bearing assembly in cleaning solvent because it will

dissolve the lubricant. To clean the shaft and bearing, merely moisten a cloth with cleaning fluid and wipe away any surplus lubricant or other foreign matter.

Be sure the face of the housing against which the seal washer turns is smooth and free from scores.

REMOVABLE BALL BEARING PUMPS—On all engines other than those listed above, the water pumps are of the removable ball bearing type, Fig. 31. When disassembling, note the arrangement of the seal parts so that the new parts may be assembled correctly.

IGNITION TIMING

ALL ENGINES—For initial or basic ignition timing, there is a timing mark on either the flywheel or vibration damper to indicate the firing position for No. 1 cylinder.

When timing ignition, crank the engine to bring No. 1 piston up on its compression stroke and stop when the ignition mark is opposite the indicator pointer. Loosen the distributor body clamp and rotate the distributor until the points close. Then turn it in the opposite direction until the breaker points just begin to open and tighten the clamp bolt.

To compensate for the grade of fuel being used, and for best performance and fuel economy, it may be necessary to alter the timing slightly from the basic setting.

GMC TRANSMISSIONS

THREE SPEED SYNCHROMESH

To disassemble, see Fig. 32 and proceed as follows:

1. Remove four cap screws from gearshift lever housing. These screws should be backed off evenly, or two of the screws should be removed and replaced with longer ones in order to relieve the tension of the gearshift lever spring before removing the retainer.
2. Remove retainer, lever, ball seat, spring and gasket. Under ordinary circumstances it is not necessary to remove the shifter assembly from the cover.
3. Remove four cap screws from transmission cover and remove cover and gasket. Note that the two front screws are special in that they have extended ends that also lock the shifter shafts in the transmission case.
4. Lift out shifter interlock.
5. Drive shift shafts from case, driving them from the rear to the front. Both of these shafts are .003" larger in diameter where they fit into the front of the case.
6. Lock transmission in two gears and remove universal yoke from mainshaft.
7. Use puller, Fig. 33, to remove main drive gear and bearing.
8. Use puller, Fig. 34, to force mainshaft forward out of rear bearing.
9. Shift second speed gear into clutch sleeve and remove these parts together with sliding gear. Take second gear thrust washer from case.
10. Expand snap ring and tap mainshaft rear bearing toward inside of case and remove (this bearing must be removed before attempting to remove the cluster gear).
11. Drive countershaft out through front and lift out cluster gear.
12. Drive idler shaft lock pin into shaft and remove shaft, idler gear and thrust washers.
13. Using tool shown in Fig. 35, remove main drive gear retaining nut and oil slinger. Then press shaft out of bearing.
14. Turn synchronizer ring in clutch sleeve until ends of ring retainers can be seen through slot in sleeve. Expand retaining ring with snap ring pliers and slip the ring out of the sleeve.

ASSEMBLY NOTES—Inspect all gears for wear or damage, and see that the first and reverse sliding gear and the clutch sleeve slide freely on the main shaft. See

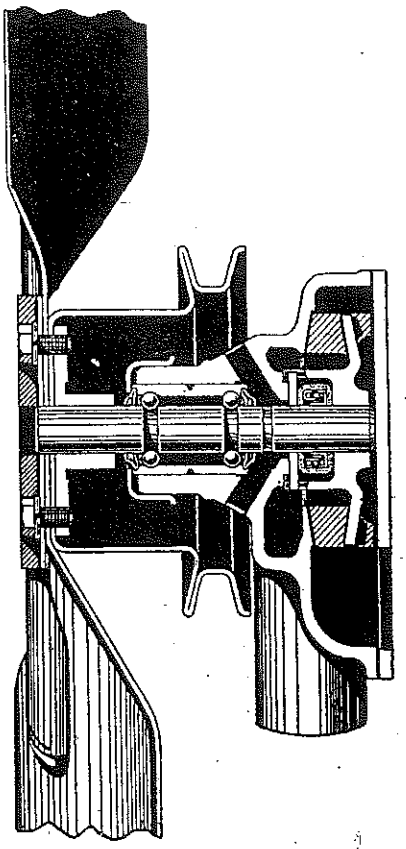

Fig. 30 Water pump on 228, 236, 248, 256 and 270 engines

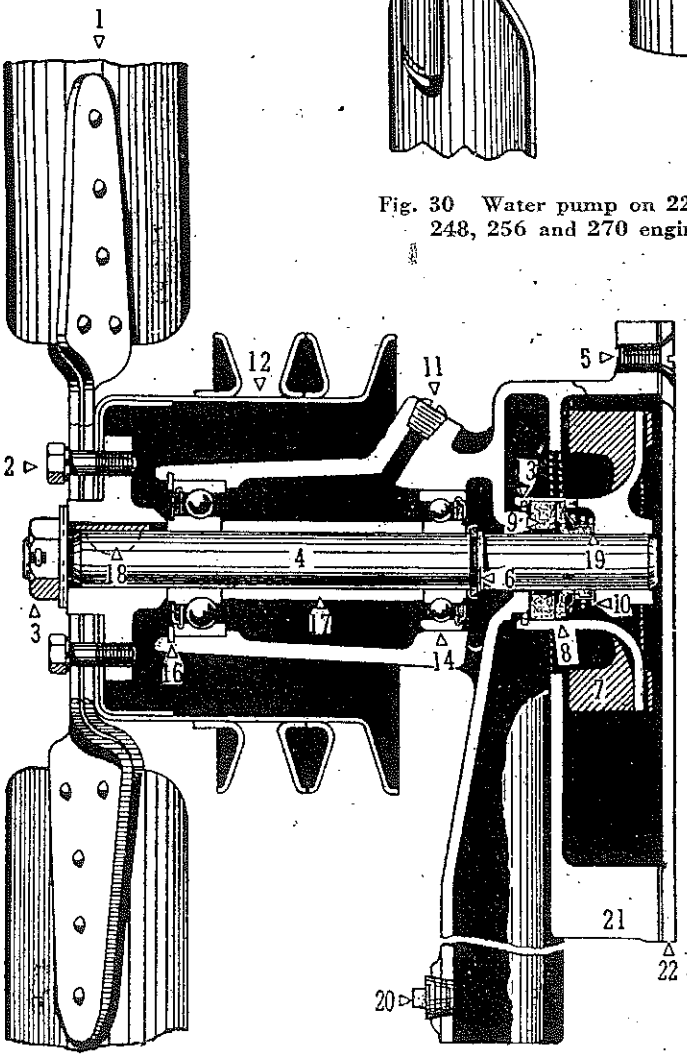

Fig. 31 Water pump. Typical of those used on 278, 308, 361, 426, 461 and 477 engines