TROUBLE SHOOTING AND SERVICE

INTRODUCTION

The McCulloch Supercharger, Model VS-57 (-A, -B, -C) is a single stage, centrifugal-type supercharger designed for use with automotive, stationary, or marine internal combustion engines. Drive take-off is from the engine crankshaft through a single, cog-type vee belt. A variable-ratio input pulley on the supercharger provides for both a "low blower" and "high blower" range of operation. Normally, when the engine is cruising (operating under minimum load requirements), the supercharger is being driven in the "low blower" range. When demand is made for power, the supercharger control system causes the pulley to be shifted into the "high blower" range.

The lubrication system is completely self-contained, eliminating connections to the engine lubricating system. An internal oil sump holds eight ounces of lubricant, Type "A" automatic transmission fluid (AQ-ATF quality). A piston-type oil pump, actuated by a cam ground into the input shaft, provides pressure lubrication of the internal moving parts. A dip-stick oil gauge inserts in the oil filler tube located in the bearing housing of the supercharger.

A planetary drive system, incorporated between the input and output shafts, serves as a speed increaser for the impeller. As the system is a ball bearing, friction-type, the use of noise producing gears is eliminated. Spring-loaded ball races serve to automatically take up any wear that might develop in the system.

The Model VS-57 supercharger has been designed for installation before the carburetor in the overall carburetion system. Under no circumstances should the supercharger be installed between the carburetor and the *intake* manifold.

McCULLOCH MOTORS CORPORATION

6101 West Century Boulevard Los Angeles 45, California

MECHANICAL OPERATION

1. GENERAL

As with all centrifugal-type superchargers, it is necessary to drive the impeller at a very high rpm rate to obtain boost pressure output. This is accomplished in the McCulloch Supercharger, Model VS-57 (.-A, -B, -C),by incorporating two speed increasers in the drive system. The first increaser is the variable-ratio input pulley, which is keyed to the input shaft. The second increaser, which operates at a constant rate, is the planetary drive system between the input and output shafts.

When a 7-1/2 inch diameter crankshaft pulley is used, the variable-ratio pulley offers a 1.3 : 1 rpm increase in the fully closed position. When the pulley is fully opened, the rpm increase is 2.3 : 1. When the pulley flanges are fully closed, the supercharger is operating in the "low blower" range. When the flanges are fully separated, the supercharger is being driven in "high blower" range and maximum boost pressure output is being produced.

The variable-ratio action of the input pulley is accomplished by the use of a sliding, rear pulley flange. -(The front pulley flange is keyed to the input shaft through a splined hub.) The rear flange is fitted with a splined bushing, that rides the input shaft splined hub, and is coupled to its actuating air piston through a thrust-type ball bearing. Movement (or shifting) of the rear flange is automatically controlled by the supercharger control system.

The control system serves to both initiate the shifting cycle and regulate the boost pressure output of the supercharger. The main component of the system is the solenoid regulator, located in the bearing housing of the supercharger. The regulator is a solenoid operated valve that controls the passage of boost pressure, taken from the discharge throat of the carburetor, into an air chamber. Within the chamber is an air piston which is coupled to the rear, or sliding flange of the supercharger input pulley.

The solenoid can be energized in one of several ways. For full automatic operation of the supercharger, it is recommended that a vacuum switch be used to close the solenoid regulator circuit. (A vacuum switch is one in which the opening and closing of the contact points is controlled by the degree of vacuum present in the engine intake manifold.)

II. DRIVE SYSTEM

The drive system of the McCulloch Supercharger, Model VS-57, as shown in Figure 1, is composed of the following component assemblies:

a. Variable-ratio input pulley

b. Input Shaft

c. Planetary drive system

d. Output shaft.

The fixed flange (A-l) of the variable-ratio input pulley (A) is keyed to the input shaft (B) through a splined hub. The sliding flange (A-2) of the pulley is fitted with a splined bushing to permit constant drive of the input shaft through the full limit of travel of the flange. Movement of the flange is controlled by an air piston (ref.) working in an air chamber, or cylinder. The pulley is shown in its maximum ratio position.

The ball driver, (C) assembled to the input shaft, serves to rotate the drive balls (D) of the planetary system around the inner faces of the outer ball-races (E). The clutch discs (F) prevent the-outer ball-races from turning in their respective seats.

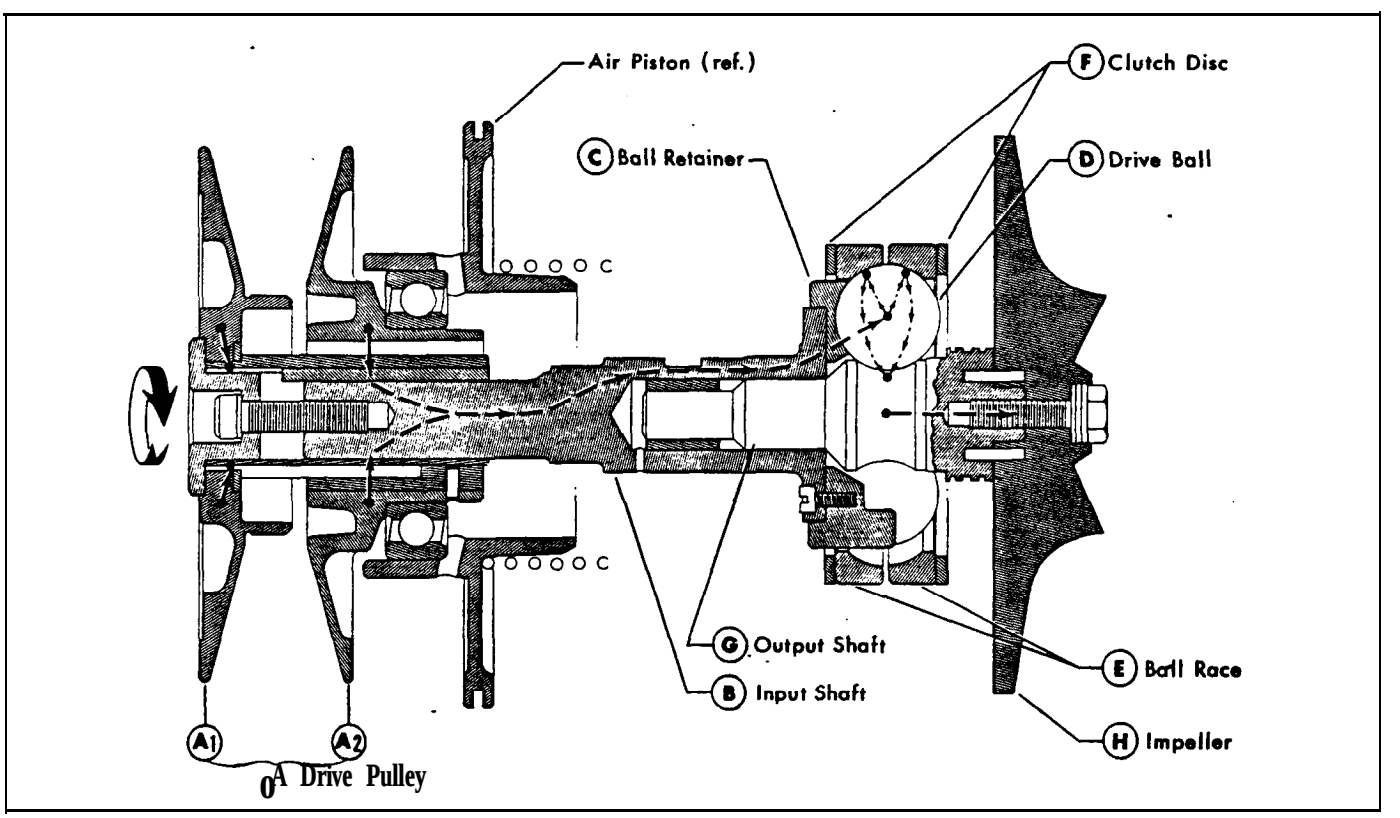


Figure 1

As the drive balls (D) revolve around the fixed cage formed by the two outer races, (E), they also rotate around their individual axis, as shown in Figure 2. This latter motion is transmitted directly to the output shaft, (G), causing it to rotate. As the output shaft serves as the inner race of the planetary system, the system ratio, 1 : 4.4, is calculated between the inner diameter of the ball races and the raceway of the output shaft.

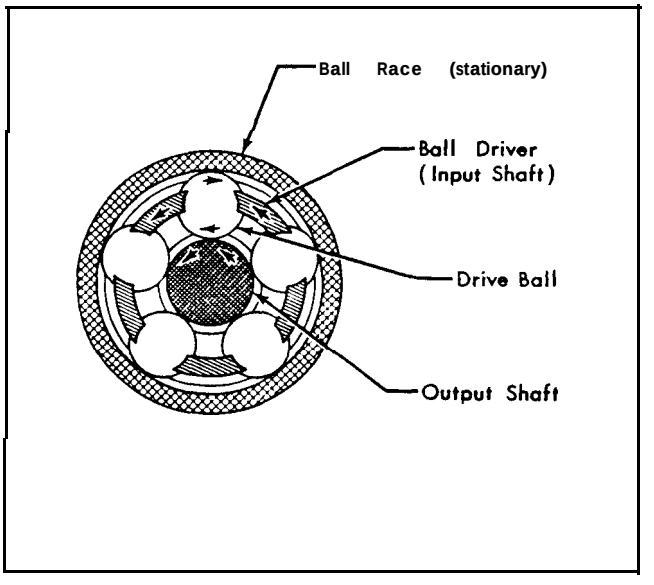


Figure 2

III. VARIABLE RATIO INPUT PULLEY

The variable ratio input pulley acts as a speed increaser (in shaft rpm) between the crankshaft pulley and the supercharger. Normally, during cruising operation (minimum load requirements), the pulley flanges will be closed and the drive belt will be at the extreme outside edge of the pulley.

Upon full throttle acceleration or demand for power,. the pulley will open and the drive belt will move to the bottom of the pulley, thereby increasing the input shaft rpm.

Shifting of the variable ratio input pulley is a result of the corn bined functions of the control system, solenoid regulator and the belt-tensioning arm and idler pulley.

When the supercharger shifts from "high blower" to "low blower"; it is a result of boost pressure (taken from the supercharger discharge throat) being passed into the air chamber, behind the air piston. The pressure drives the piston forward and the movement is transmitted to the sliding flange of the pulley assembly through a thrust-type ball bearing. The pressure is sufficient to overcome. the tension applied to the drive belt by the belt-tensioning arm and, as the pulley flanges close, the belt is forced to the top of the pulley. An equalizer spring behind the piston helps to overcome the effect of the tensioning arm against the drive belt.

NOTE

During idle speed engine operation, the drive belt and variable-ratio pulley are in the "high blower" position. This is because the developed boost pressure is insufficient to override the tension exerted against the drive belt by the belt-tensioning arm.

During the shift cycle from "low blower" to "high blower", a valve in the control system closes to prevent boost pressure from entering the air chamber. The pressure within the chamber bleeds off and the tension on the drive belt (exerted by the belt-tensioning arm) causes the belt to pull down into the pulley and separate the two flanges.

The time required for either phase of the shifting cycle is approximately one second.

The belt-tensioning arm is generally mounted on the same bracket used to mount the supercharger. The spring-loaded arm is geometrically located with relation to the center line of the supercharger input shaft. The existing design should not be altered in any way as such alteration will affect the shifting cycle of the variable -ratio pulley.

IV. CONTROL SYSTEM

The control system of the Model VS-57 supercharger serves to both initiate the shifting cycles of the unit and to regulate the boost output pressure. This is accomplished by controlling the movement of the sliding flange of the input pulley to either increase or decrease the effective working diameter of the pulley. The design makes possible three phases of supercharger operation, as follows:

Phase A - Cruise Range, or Low Blower

Phase B - Power Demand, or High Blower

Phase C - Regulation (regulated high blower)

In effect, the control system is an electrically operated valve which controls the passage of boost pressure from the discharge throat into the air chamber.

The main electrical component of the system is the solenoid regulator, which is energized by the closing of an external switch. Located in the bearing housing, the regulator intersects an air passageway leading between the discharge throat and the air chamber containing the air piston. The external switch can be either a vacuum switch, operated off the intake manifold; or a kick-down type switch operated by depressing the accelerator pedal.

The three phases of supercharger operation, as shown in Figure 3, are:

Phase A

The solenoid regulator is not energized and the valve is open, permitting boost pressure to enter the air chamber. The air piston is driven forward, closing the variable-ratio pulley, and the supercharger is operating in "low blower". Minimum horsepower is required to drive the supercharger during this phase, as the supercharger is not producing high level output. This phase extends across the cruising range of the engine, where the engine does not demand, and cannot use, boost pressure. Upon acceleration, or full load engine demand, the supercharger shifts into Phase B operation.

NOTE

When the solenoid is energized by means of an external vacuum switch, Phase B operation is initiated when the intake manifold vacuum rises to zero.

Phase B

As soon as the solenoid regulator is energized, the armature lifts and seals against the valve stem to block the passage of boost pressure into the air chamber. When the source of constant pressure is removed from behind the air piston, the pressure that exists in the chamber bleeds off. The tension exerted against the drive belt by the belt-tensioning arm causes the belt to pull down into the variable-ratio pulley. As the sliding flange moves backward, driving the air piston back into the air chamber, the effective working diameter of the pulley is reduced and the rpm speed of the input shaft is increased. The supercharger is now in the "high blower" range of operation and the boost pressure output, in psi, is increased.

As the engine speed increases under full throttle, the boost pressure output also continues to increase until it reaches a predetermined level, based upon the setting of the solenoid regulator. At this point, the solenoid regulator enters Phase C operation to regulate the output of the supercharger.

Phase C

The design of the supercharger and drive system is such that maximum boost pressure output is produced at a crankshaft speed below maximum engine rpm.

This permits production of usable boost pressure. at lower engine speeds and also increases the range of engine speeds over which usable boost pressure is produced. However, if maximum output is produced at a mid-range speed of the engine, it is obvious that pressure output would continue to increase as the engine speed increases to maximum rpm. Therefore, it is necessary to regulate the pressure output, in psi, to a level that is compatible with engine design and available fuel.

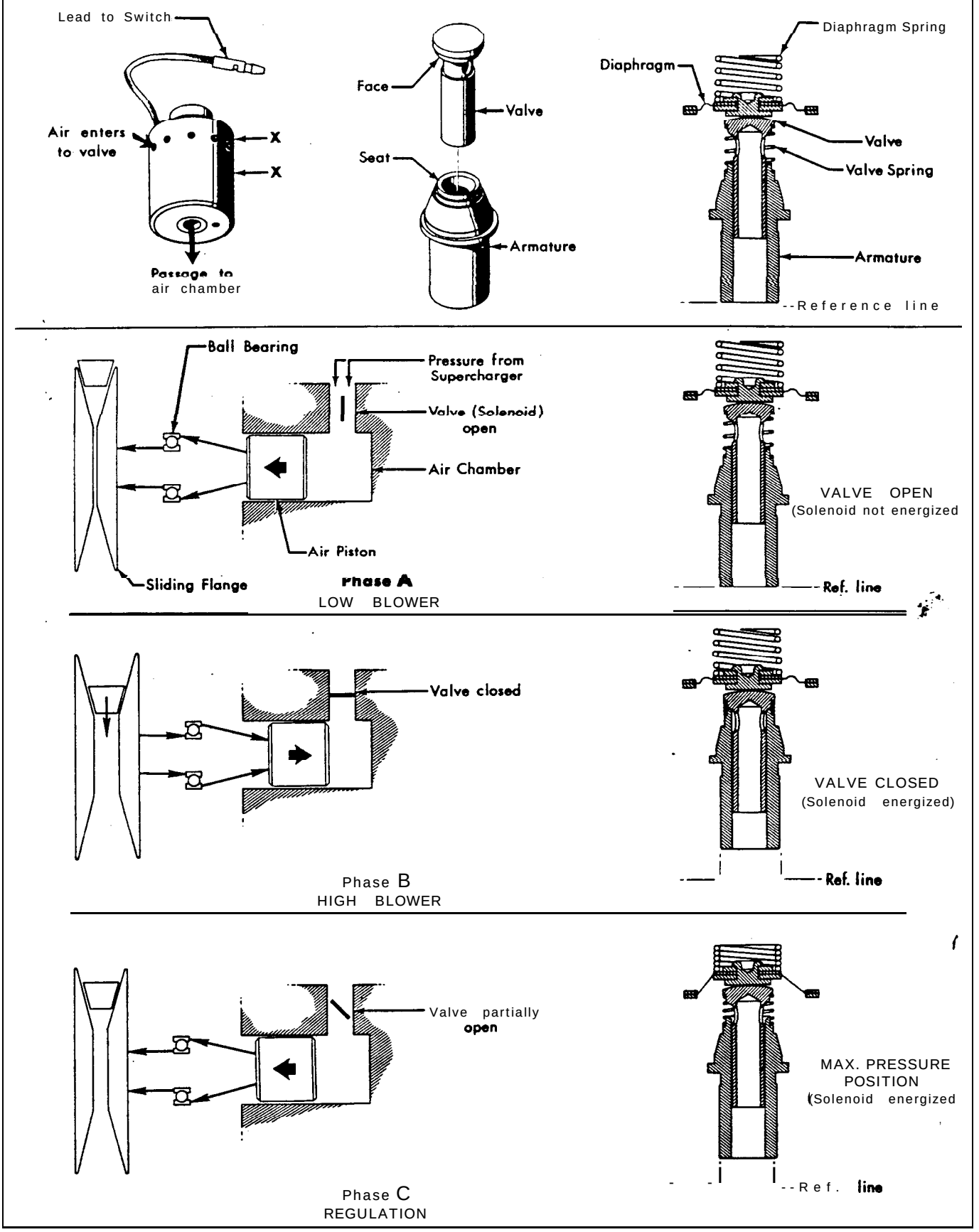

Lead to Switch
Air enters to valve
X
X
Passage to air chamber
Face
Valve
Seat
Armature
Diaphragm Spring
Diaphragm
Valve
Valve Spring
Armature
--Reference line
Ball Bearing
Pressure from Supercharger
Valve (Solenoid) open
Air Chamber
Air Piston
Sliding Flange
Phase A
LOW BLOWER
VALVE OPEN
(Solenoid not energized
Ref. line
Valve closed
Phase B
HIGH BLOWER
VALVE CLOSED
(Solenoid energized)
Ref. line
Valve partially open
Phase C
REGULATION
MAX. PRESSURE POSITION
(Solenoid energized
--Ref. line

Figure 3

This is accomplished by the inclusion of a spring loaded diaphragm within the case of the solenoid regulator. A spring on the top side of the diaphragm is adjustable (by means of an adjusting screw) and the change of spring rate determines the pressure, in psi, required to distend and lift the diaphragm. As the diaphragm is positioned against the head of the valve, any upward movement permits the valve to lift off the seat formed by the armature. It is this function that comprises the Phase C operation of the solenoid regulator. The mechanical operation is as follows.

During "high blower" operation, the solenoid is energized and the armature has moved upward to seal off the passage of boost pressure into the air chamber. As the engine speed continues to increase and the boost pressure output reaches the level for which the diaphragm spring has been preset, (for example: 4 psi) any pressure gain over four pounds will cause the diaphragm to distend. This permits the valve to lift off the seat to a like degree, thus opening the passageway to the air chamber. As the equalizing spring behind the air piston is in a compressed state, neutralizing the tension exerted against the drive belt by the belt-tensioning arm, the small amount of pressure passing the partially opened valve is sufficient to cause the air piston to move forward. This action, in turn, causes the sliding flange of the variable-ratio pulley to move forward and the effective working diameter of the pulley is reduced. As the pulley ratio changes, the rpm of the input shaft is reduced and boost pressure output is also reduced to the regulated level.

This regulating action continues through the high end of the engine speed (in rpm) curve until the full limitation of the diaphragm has been reached. However, the overall design of the supercharger and control system is such that the limit of regulation holds very closely to the maximum usable engine rpm.

V. LUBRICATION

The supercharger Model VS-57 (-A, -B, -C) is lubricated through the utilization of an internal, piston-type oil pump working off a cam ground into the input shaft. The oil sump holds eight ounces of lubricant, and changing of the lubricant is not required except under extreme conditions of operation.

WARNING

The supercharger lubrication system is designed to use only Type A automatic transmission fluid (AQ-ATF quality). Under no circumstances should any tier, type of lubricant be used or added to the oil sump. This warning includesthe use of friction-reducing compounds or fluids, and their use will void the supercharger warranty.

A dip-stick type oil gauge, inserted in the oil filler tube located in the bearing housing, indicates the level, and safe operating range of the lubricant in the sump. The supercharger should never be operated with the dip-stick removed from the filler tube as loss of lubricant will result.

The oil level within the supercharger should be checked each time the engine oil is checked. Under normal operation it should not be necessary to add lubricant to the sump between intervals of 1500 to 2000 miles of operation.

WARNING

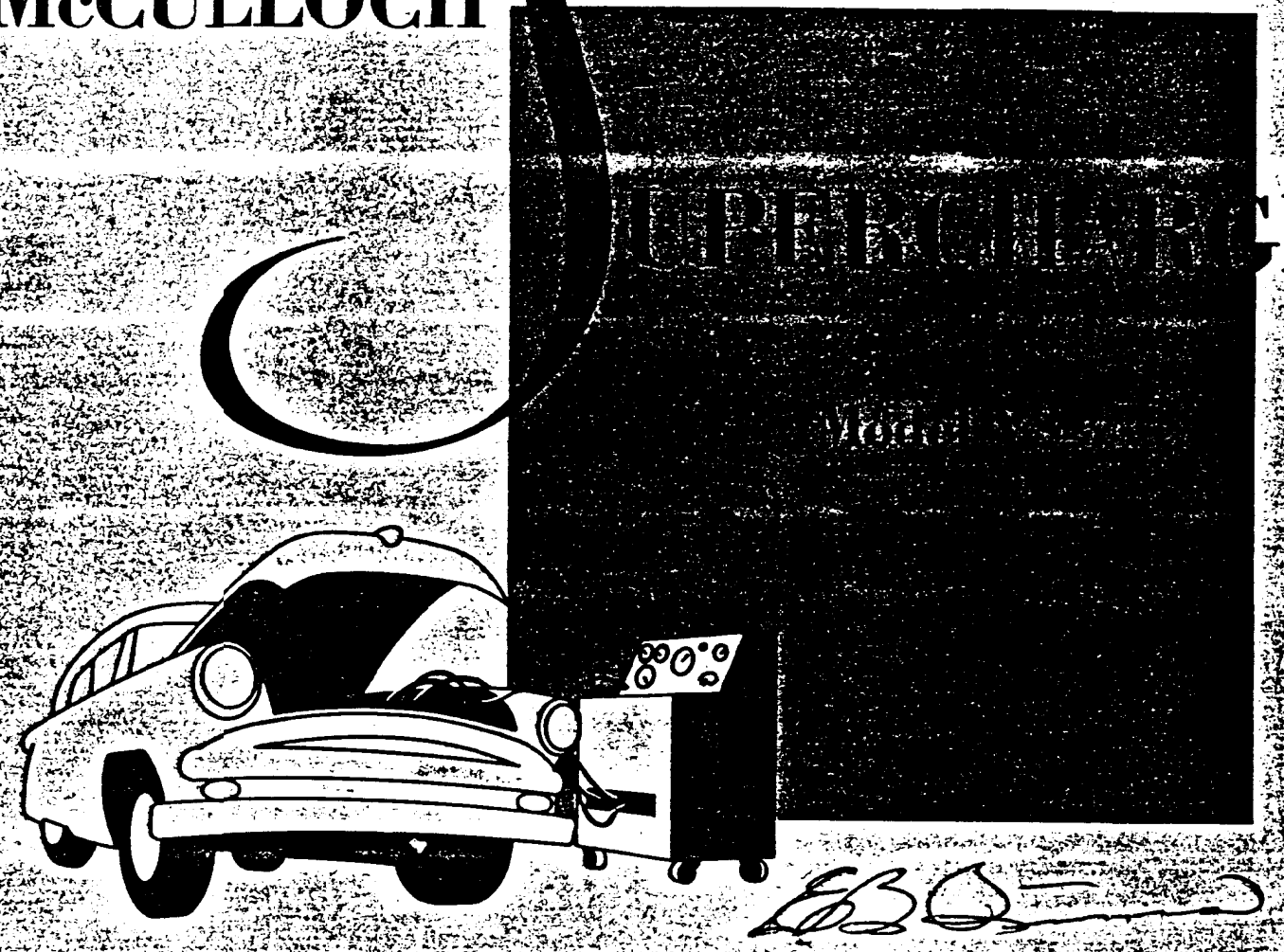
Should excessive oil consumption occur, the supercharger should be taken to an authorized McCulloch Supercharger Dealer for checking. If this is not convenient, it is recommended the supercharger drive belt be removed and the supercharger not operated until such time that a thorough check can be made.

Under normal operation, the lubricant within the supercharger should retain its original color without darkening or formation of sludge. Therefore, when checking lubricant level, wipe the dip-stick with either a clean cloth or paper and check for condition of lubricant. Extreme darkening or the presence of foreign matter in the lubricant is sufficient cause for draining and thoroughflushing of the lubricant sump. After flushing, refill the sump with eight ounces of Type A automatic transmission fluid (AQ-ATF quality).

NOTE

It is recommended the supercharger be taken to an authorized McCulloch Supercharger Dealer for servicing when flushing of the internal lubricant sump is indicated.

McCULLOCH SUPERCHARGER



INSTALLATION
AND
OPERATION
TROUBLESHOOTING

McCULLOCH SUPERCHARGER

PAXTON PRODUCTS

Division of McCulloch Motors Corporation

827 WEST OLIVE STREET - INGLEWOOD, CALIF.