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TROUBLE SHOOTING OF DIESEL ENGINE

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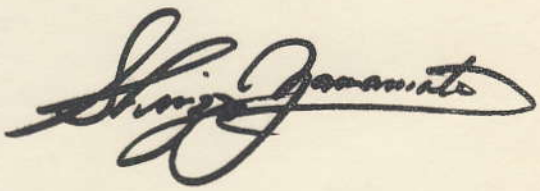
Foreword

This textbook on Trouble-shooting of Diesel engine has been compiled for use by the Regional Training Course for Fishery Extension Officers in Marine Capture Fisheries and also for use by the Marine Engineering Course trainees of the Training Department, SEAFDEC.

The Diesel engine has proven itself to be a dependable source of economical power, especially in the marine field. However, in spite of the recent considerable technical progress, it is not possible to guarantee one hundred percent reliability of the Diesel engine. Even with correct operation and good maintenance, troubles may occur; they should be detected in early stages and corrective action should be taken immediately. Failure to do so may have catastrophic consequences for the crew or at least lead to heavy economic losses.

It would be outside the scope of this textbook to describe all possible kinds of Diesel engine trouble, as it would require a high degree of technical expertise and experience. Here we endeavor to give a perspective view of trouble-shooting methods, as had been promised in our earlier textbook "Operation and Maintenance of Diesel Engine" (TRB/No.10, SEAFDEC 1980).



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Introductory Notes

Indications of Troubles and Causes

General Means for Trouble Detection

Discrimination of Troubles and Detection of their Location

Even if engine troubles are very trivial, they progress to cause great damage unless detected and repaired in their early stages.

Because marine engine troubles occasionally plunge crews into danger due to total failure in cases of emergency, any operator of diesel engines should also be able to detect troubles.

Good operator should fulfill the following requirements.

(1) As soon as the operator sees, hears, smells or feels indications of troubles, he must be able to discriminate them. He can determine the causes by discrimination analysis.

(2) The operator should be able to determine what repairs are necessary immediately after he has ascertained the location of the engine trouble.

The fact that most engines will continue to operate after developing serious troubles should be thoroughly acknowledged. However, indications of impending troubles generally appear in advance, in most cases. One of the best methods of trouble dectection is (1) instrument indication should be read regularly and recorded in the log.

When instrument readings differ greatly from those described in the operations manual, the operator should be aware of the need for adjustment because the engine will not operate satisfactorily. He should also consider the effect these different values will have on the engine.

The proper meanings shown by pressure or temperature readings largely depend on the arrangement of instruments in the system. Therefore, the operator should be well informed of instrument arrangements. Another good method of trouble detection is (2) abnormal noises occurring in the engine during operation should be watched.

(3) A trouble detector should inspect the engine regularly in order to detect troubles at visible portions, smoke, and leakage of lubricant oil, fuel oil and water. Leaks can be detected easily if the outer portions of engine pipes are always kept clean. Therefore, cleaning the engine room not only deeps it in order and makes dwelling comfortable, but is also helpful in detecting engine troubles.

As soon as indications of trouble appear, the operator should perform several operations without delay. First, he should judge whether or not it is necessary to stop the engine immediately. When the engine becomes noisy and instrument indications are abnormal, it should be stopped in most cases. If the engine operation is continued under such conditions, it will be liable to serious damage. For small damage such as pipe leakage, it is desirable to make repairs without suspending engine operations. It is the operator's duty to determine whether or not the engine should be stopped, considering the seriousness of the trouble and current demands on the ship. As soon as he has stopped the engine, he should promptly begin to look for the cause of the trouble. It is not easy to inspect every portion of the engine whenever engine trouble occurs. Therefore, the operator should make a logical, systematic inspection to promptly determine the cause of the trouble.

The best method is to analyze what engine system the trouble is in, that is, the intake system, the lubrication system, the fuel system, etc. The next step is to investigate the system until the trouble becomes clear. This analysis is possible, because troubles generally begin in only one system. It should be borne in mind, however, that troubles occurring in one system may cause damage to other systems.

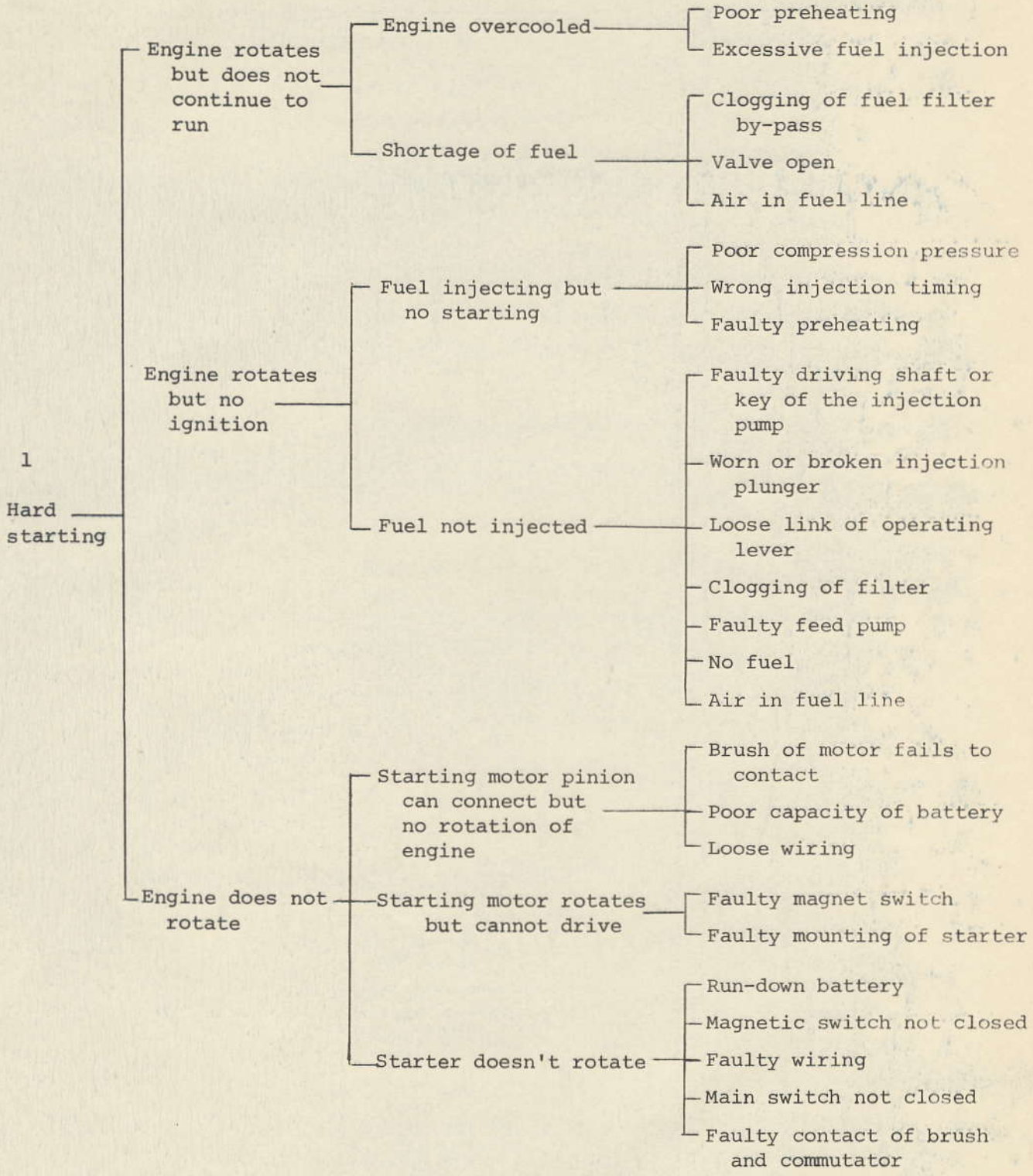
When two or more engine systems have defects at the same time, each system should be analyzed separately and fully investigated to determine the location of the defects, and the defects should then be repaired. The operator should understand each system thoroughly and know the functions of each portion of the system fully.

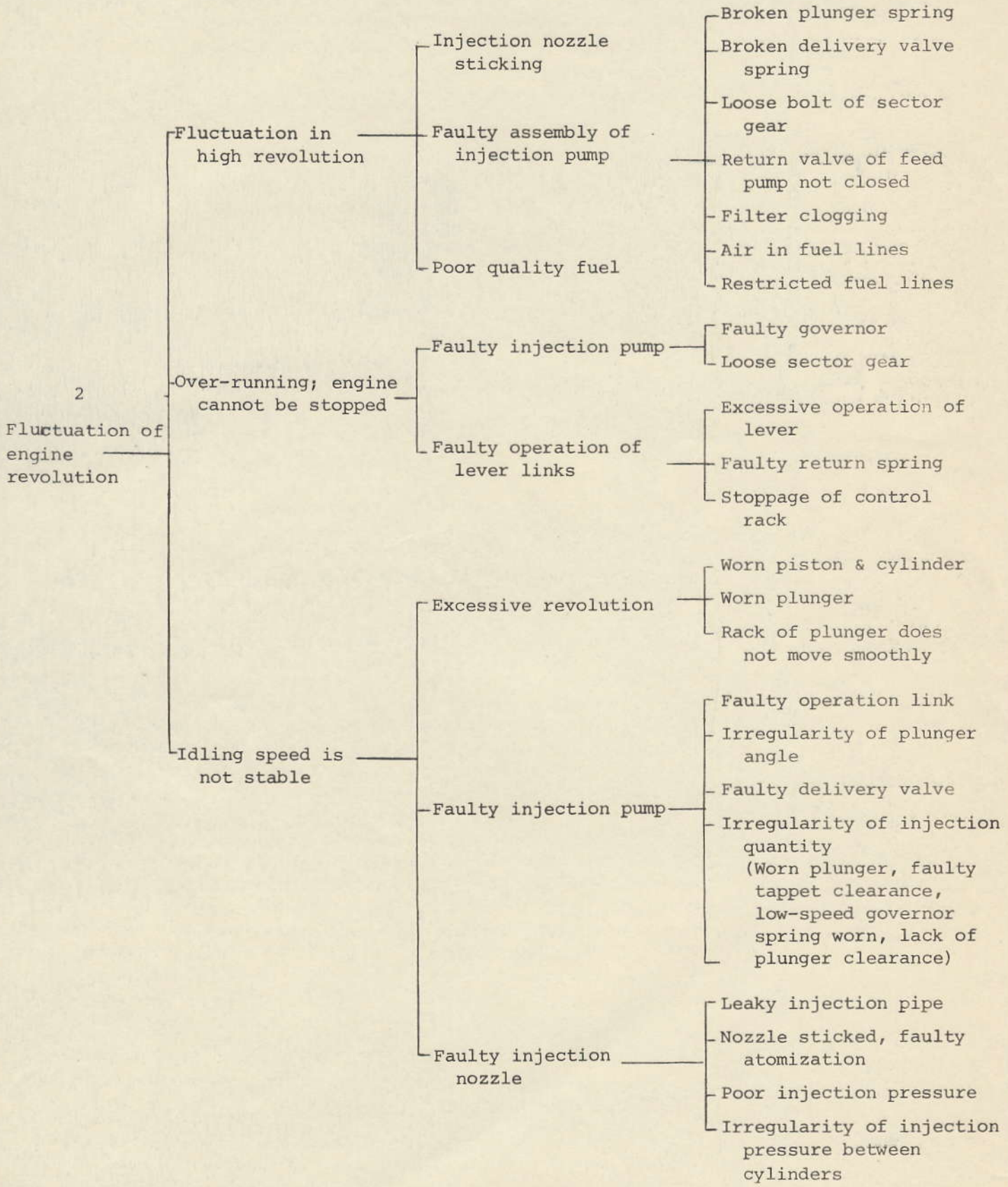
Such knowledge can be obtained by studying the engine mechanisms thoroughly. The trouble detector can save much time by analyzing indications of trouble before operations and ascertaining which portion of the system shows the indications observed. He should first inspect the portion most easily repairable.

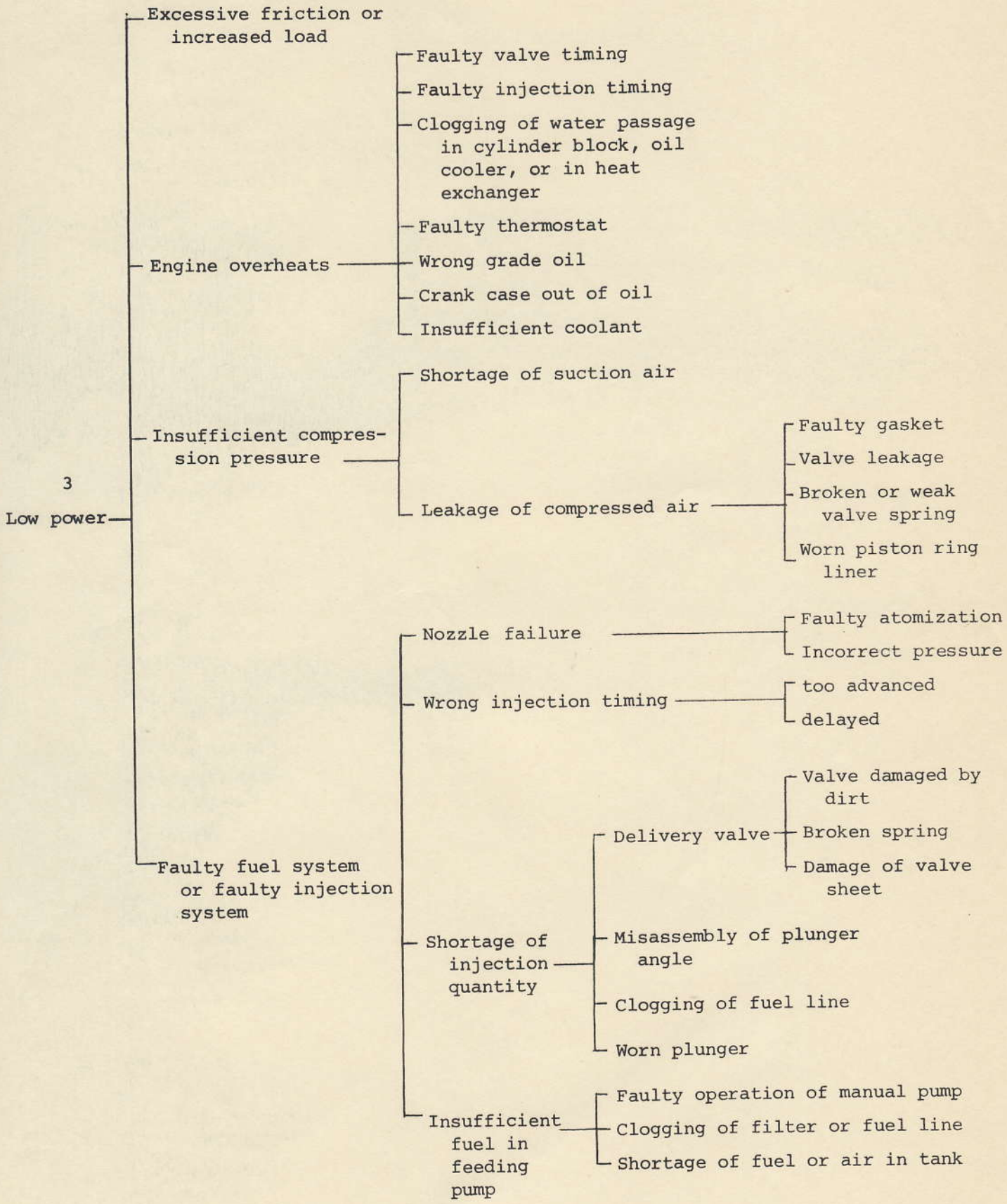
Notwithstanding indications showing obvious troubles in the engine system, it is sometimes difficult to locate them because each portion of the system performs properly. The investigation should start from the first stage of the system and be carried on until the cause of the trouble can be detected. Though experience is an important factor for trouble detection, the operator who studies the engine, exercises common sense and strives to freely use his latent ability for detection will have the ability to diagnose engine troubles promptly and exactly and to repair them.

POOR COMBUSTION	ENGINE OVERHEATS	HIGH OIL TEMPERATURE
Possible Cause Leaky valve or valves Stuck piston rings Subnormal water jacket temperatures Worn cylinders Intake or exhaust ports clogged (2 cycle-engines) Light loads Cold intake air Overlubricated cylinder walls	Possible Cause Lack of cooling water Incrustations in water jacket Obstruction to circulation of water Damage to water pump Fuel injection too late Inadequate lubrication	Possible Cause Overheated bearing surfaces Not enough oil in circulation High water jacket temperatures Crankcase insufficiently cooled Plugged oil cooler Oil badly contaminated Late combustion Overloading
EXHAUST SMOKE	COMBUSTION CHAMBER DEPOSITS	SUDDEN STOPPAGE
Possible Cause Weak compression Sticking or worn nozzle Cetane fuel too low Excessive amount of oil reaching combustion chamber Unequal power output of cylinder Dirty air filter or silencer Misfiring Leaky inlet or exhaust Inadequate air supply Sticky or worn piston rings Inlet air or jacket water too cool Worn or scored cylinders	Possible Cause Dust from air Imperfect combustion Unsuitable oil	Possible Cause No fuel Water or air in fuel line Too heavy fuel Dirt or gum in fuel Plugged fuel line Lubrication failure Overheated engine Seized or tightened moving part of engine
	ENGINE ROUGHNESS	
	Possible Cause Imperfect injection Cetane number of fuel too low Injection timing too early	

The correct diagnosis of trouble when using such a table requires a careful inspection to determine not which item is the cause, but how many items are contributing to the trouble, one of which is the primary trouble maker. For example, assume that poor combustion is indicated by black exhaust, the table lists 20 possible causes, many of which are interrelated. Other examples of high speed diesel engine troubles which are classified under three headings (1) Hard starting, (2) Fluctuation of engine revolution, (3) Low power, are given below.


1
Hard starting
Engine rotates but does not continue to run
Engine overcooled
Poor preheating
Excessive fuel injection
Shortage of fuel
Clogging of fuel filter by-pass
Valve open
Air in fuel line
Engine rotates but no ignition
Fuel injecting but no starting
Poor compression pressure
Wrong injection timing
Faulty preheating
Fuel not injected
Faulty driving shaft or key of the injection pump
Worn or broken injection plunger
Loose link of operating lever
Clogging of filter
Faulty feed pump
No fuel
Air in fuel line
Engine does not rotate
Starting motor pinion can connect but no rotation of engine
Brush of motor fails to contact
Poor capacity of battery
Loose wiring
Starting motor rotates but cannot drive
Faulty magnet switch
Faulty mounting of starter
Starter doesn't rotate
Run-down battery
Magnetic switch not closed
Faulty wiring
Main switch not closed
Faulty contact of brush and commutator


2
Fluctuation of engine revolution
Fluctuation in high revolution
Injection nozzle sticking
Faulty assembly of injection pump
Broken plunger spring
Broken delivery valve spring
Loose bolt of sector gear
Return valve of feed pump not closed
Filter clogging
Air in fuel lines
Restricted fuel lines
Poor quality fuel
Over-running; engine cannot be stopped
Faulty injection pump
Faulty governor
Loose sector gear
Faulty operation of lever links
Excessive operation of lever
Faulty return spring
Stoppage of control rack
Idling speed is not stable
Excessive revolution
Worn piston & cylinder
Worn plunger
Rack of plunger does not move smoothly
Faulty injection pump
Faulty operation link
Irregularity of plunger angle
Faulty delivery valve
Irregularity of injection quantity (Worn plunger, faulty tappet clearance, low-speed governor spring worn, lack of plunger clearance)
Faulty injection nozzle
Leaky injection pipe
Nozzle sticked, faulty atomization
Poor injection pressure
Irregularity of injection pressure between cylinders


3
Low power
Excessive friction or increased load
Engine overheats
Faulty valve timing
Faulty injection timing
Clogging of water passage in cylinder block, oil cooler, or in heat exchanger
Faulty thermostat
Wrong grade oil
Crank case out of oil
Insufficient coolant
Insufficient compression pressure
Shortage of suction air
Leakage of compressed air
Faulty gasket
Valve leakage
Broken or weak valve spring
Worn piston ring liner
Faulty fuel system or faulty injection system
Nozzle failure
Faulty atomization
Incorrect pressure
Wrong injection timing
too advanced
delayed
Shortage of injection quantity
Delivery valve
Valve damaged by dirt
Broken spring
Damage of valve sheet
Misassembly of plunger angle
Clogging of fuel line
Worn plunger
Insufficient fuel in feeding pump
Faulty operation of manual pump
Clogging of filter or fuel line
Shortage of fuel or air in tank

FIGURES

Fig. 1 : Engine fails to start or is difficult to start

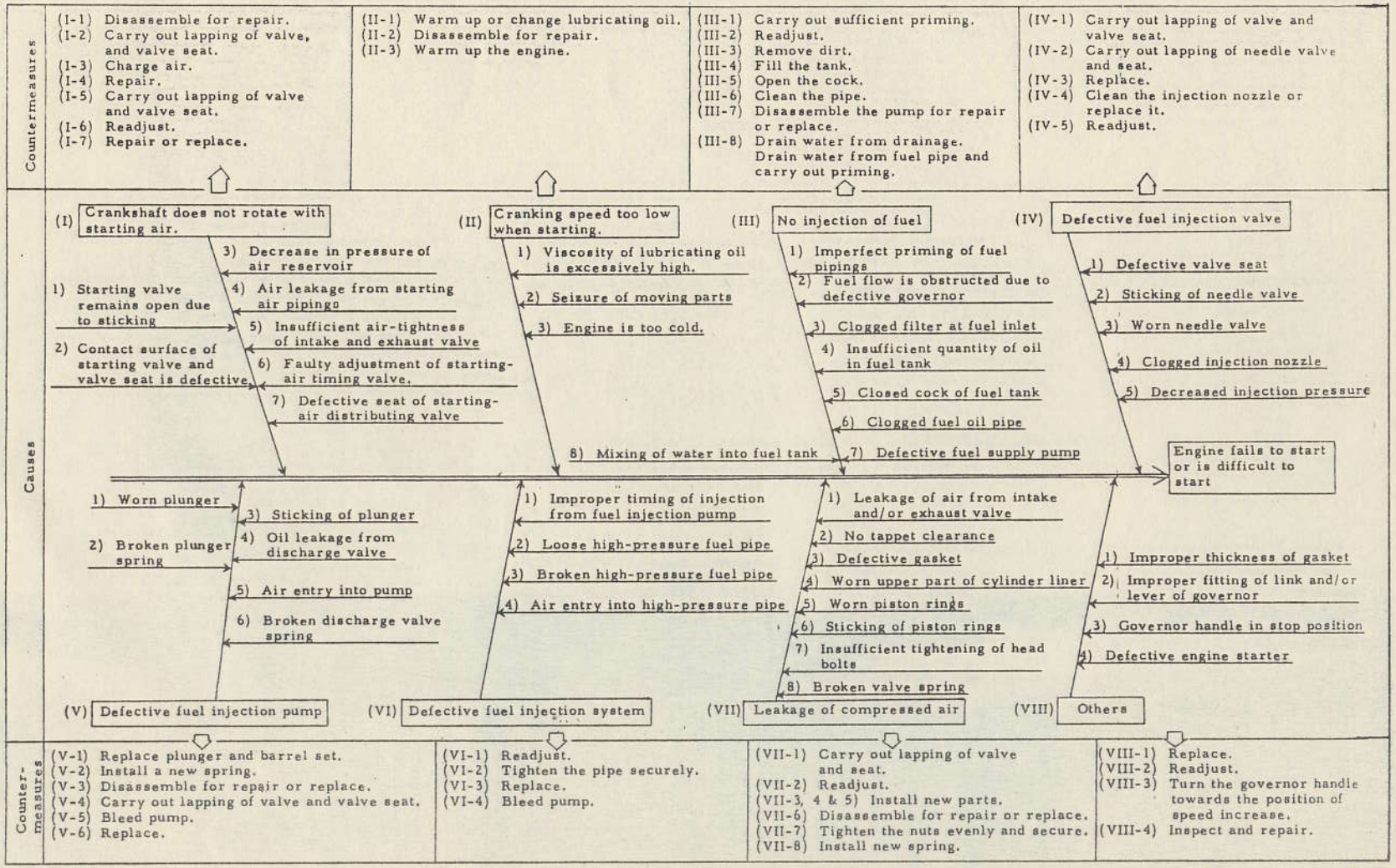


Fig. 2 : Insufficient Output

Fig. 2

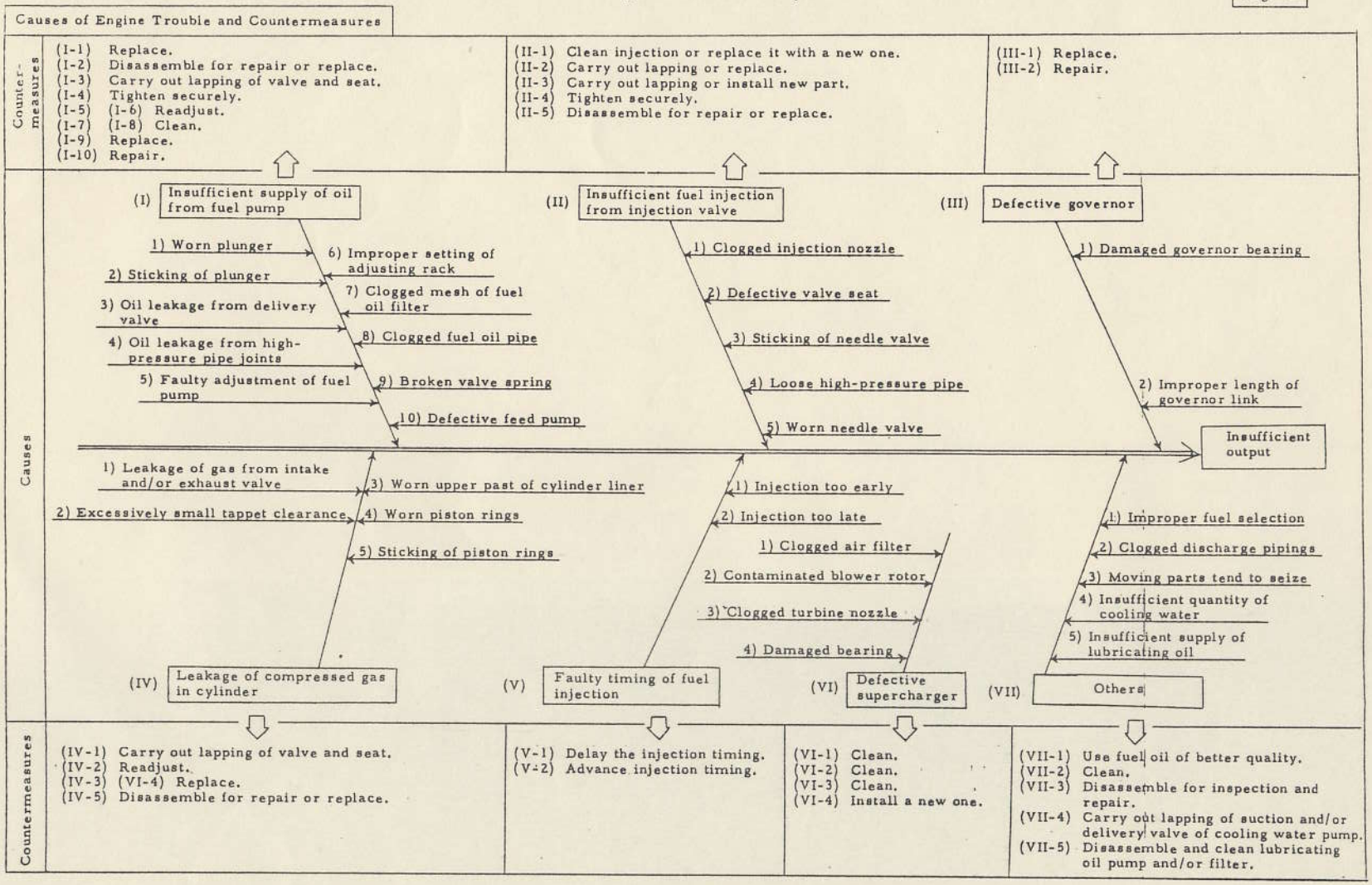


Fig. 3 : Irregular Revolutions

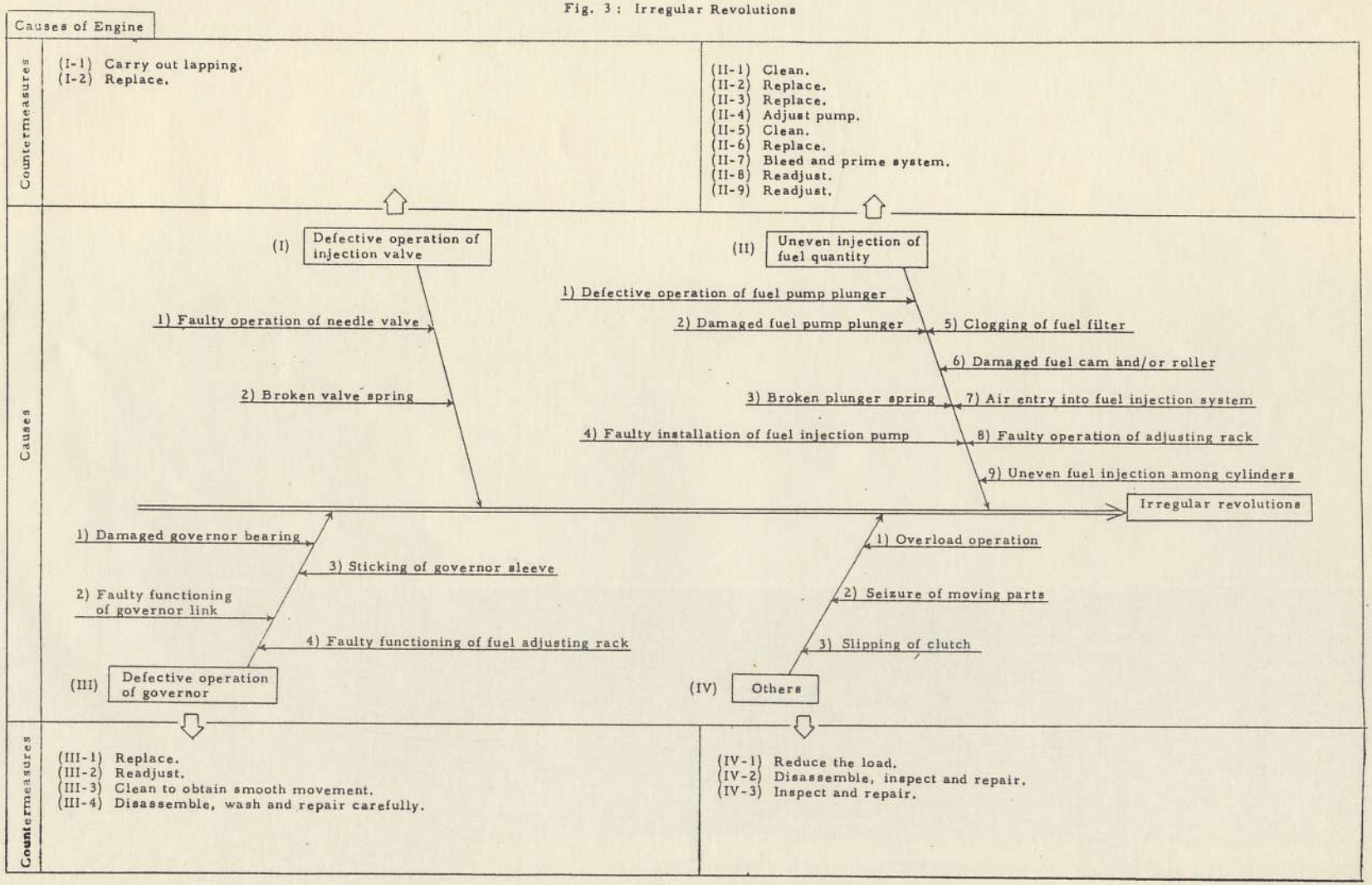


Fig. 4 : Engine Knocking

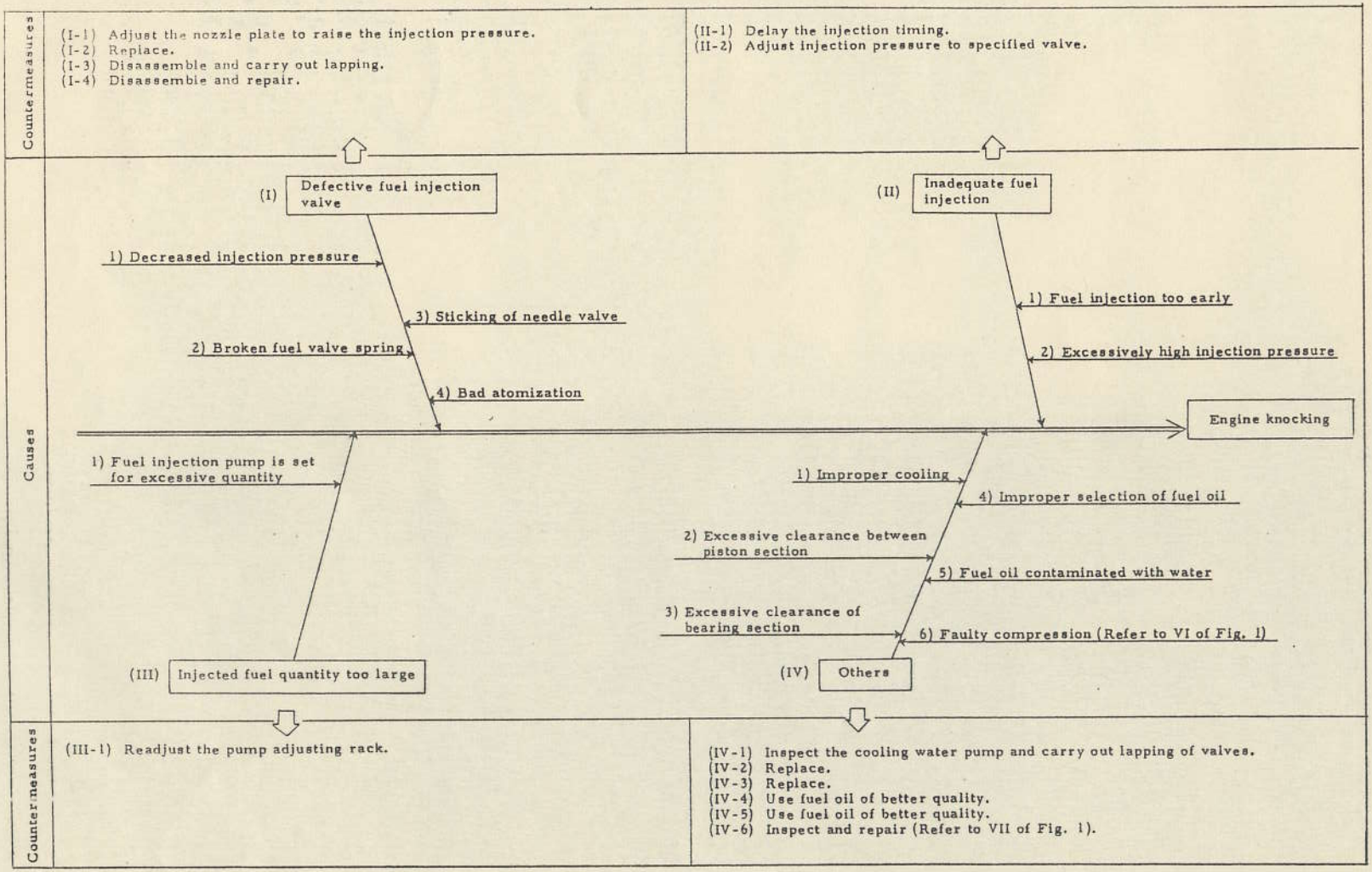


Fig. 5 : Engine Stops Suddenly

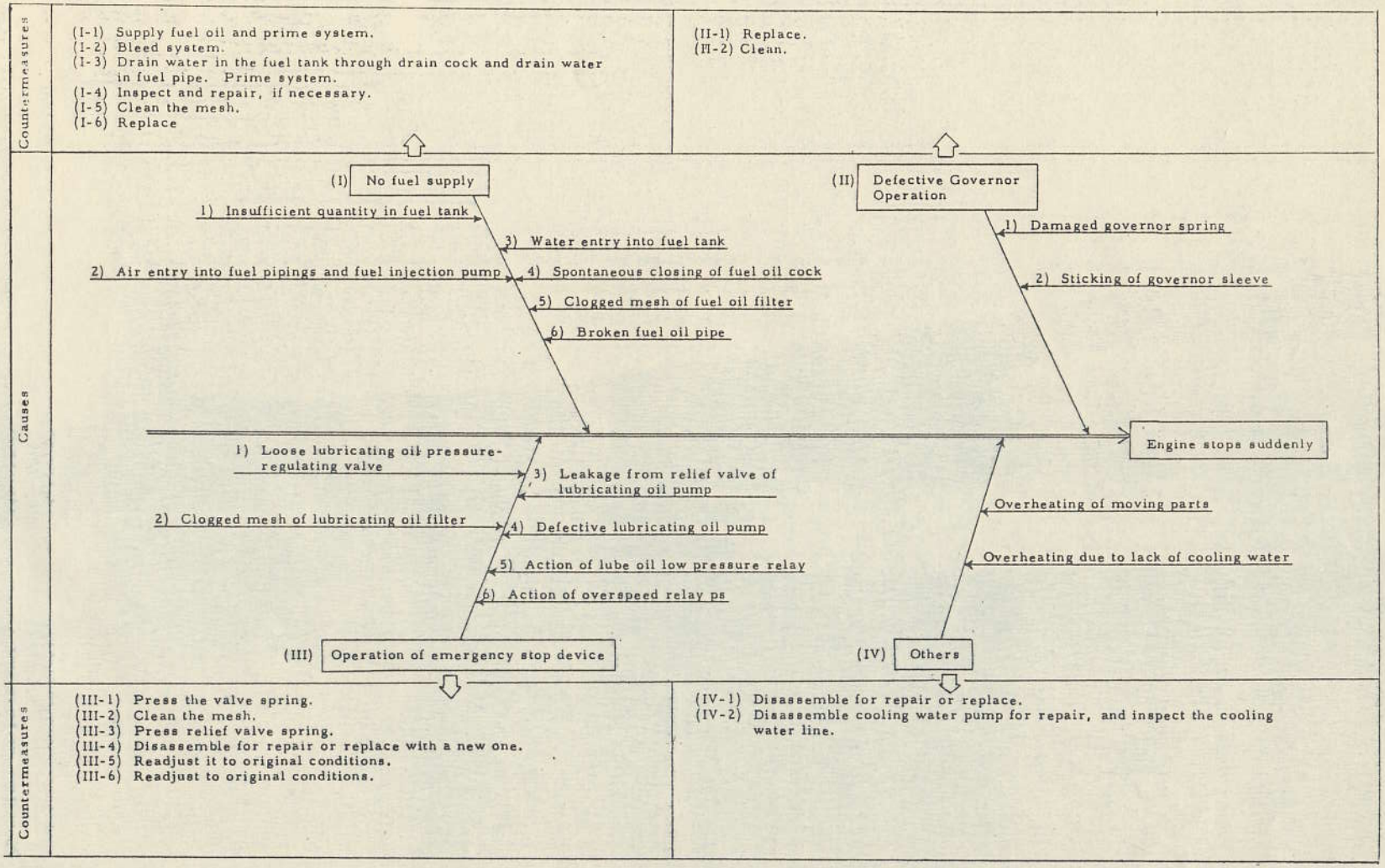


Fig. 6 : Uneven Load Distribution Among Cylinders

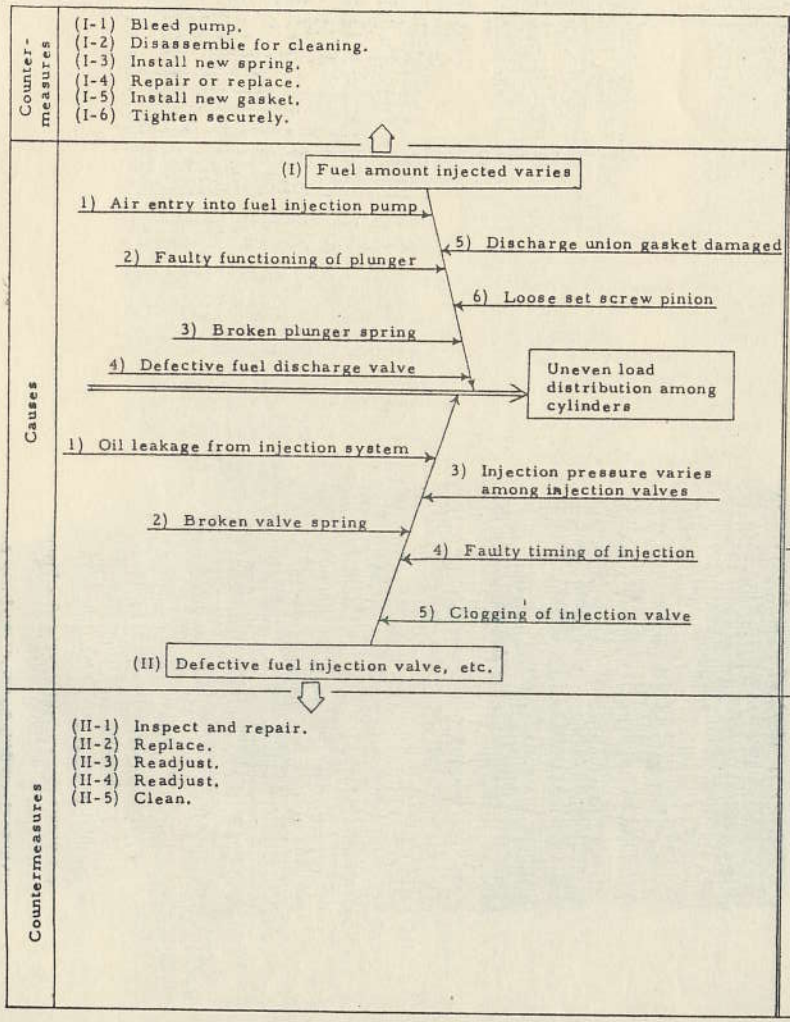


Fig. 7 : Abnormal Colour of Exhaust

Fig. 7

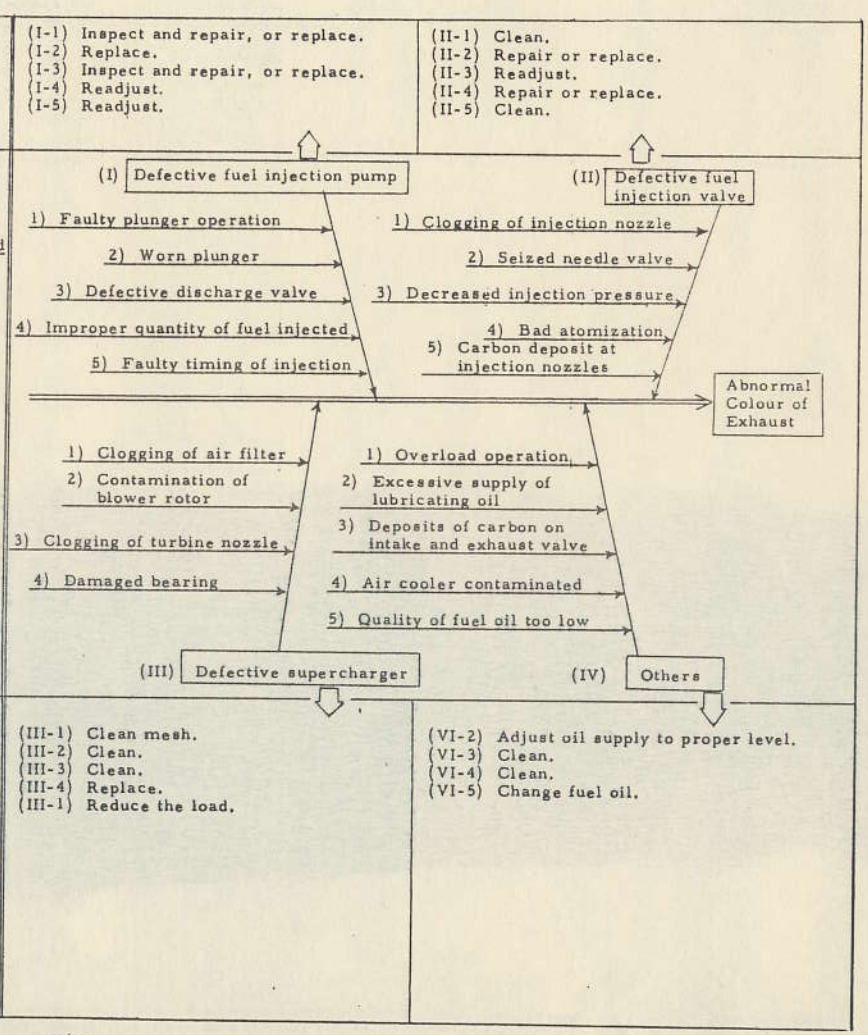


Fig. 8 : Defective Reduction and Reversing Gear

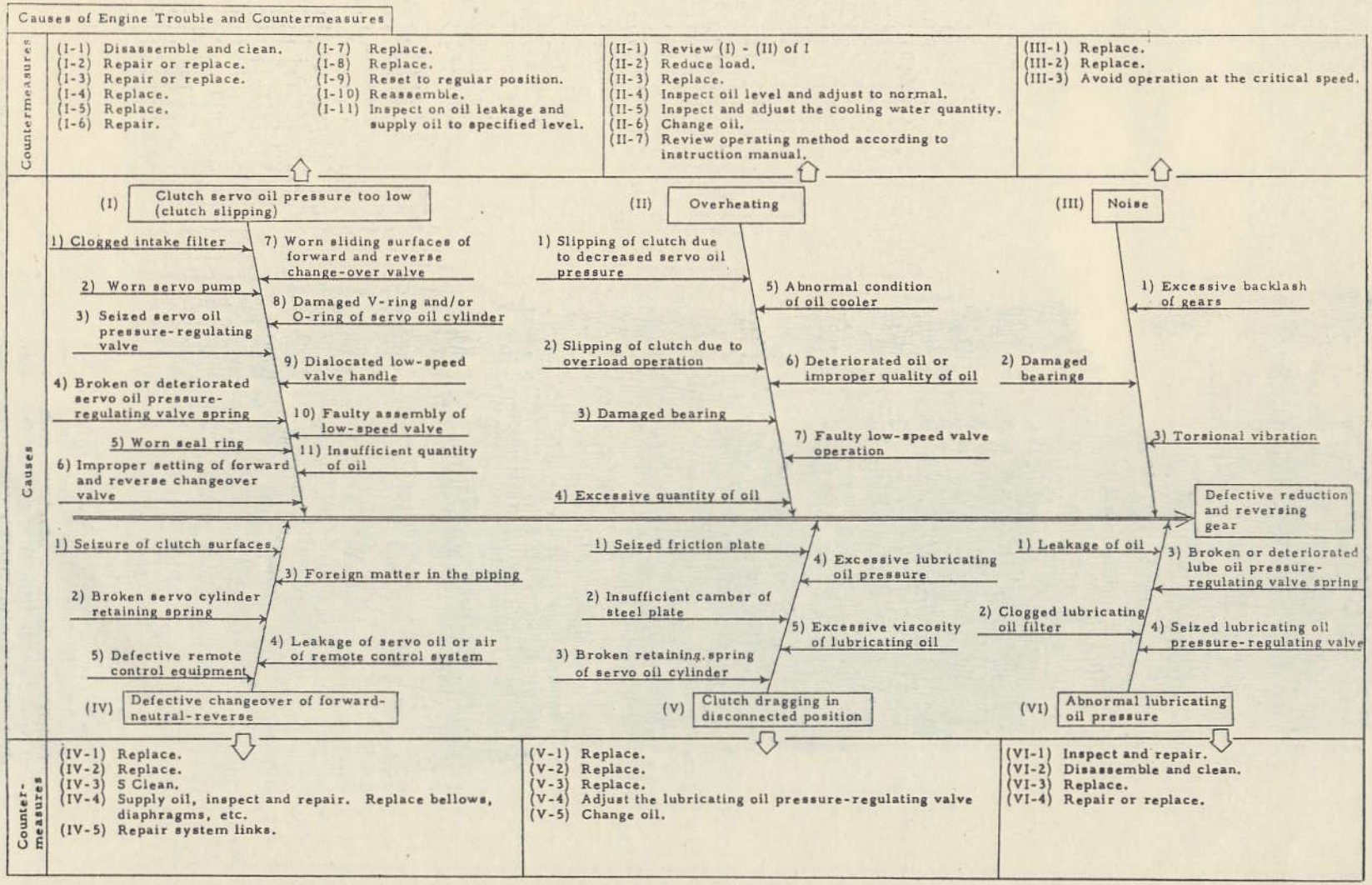
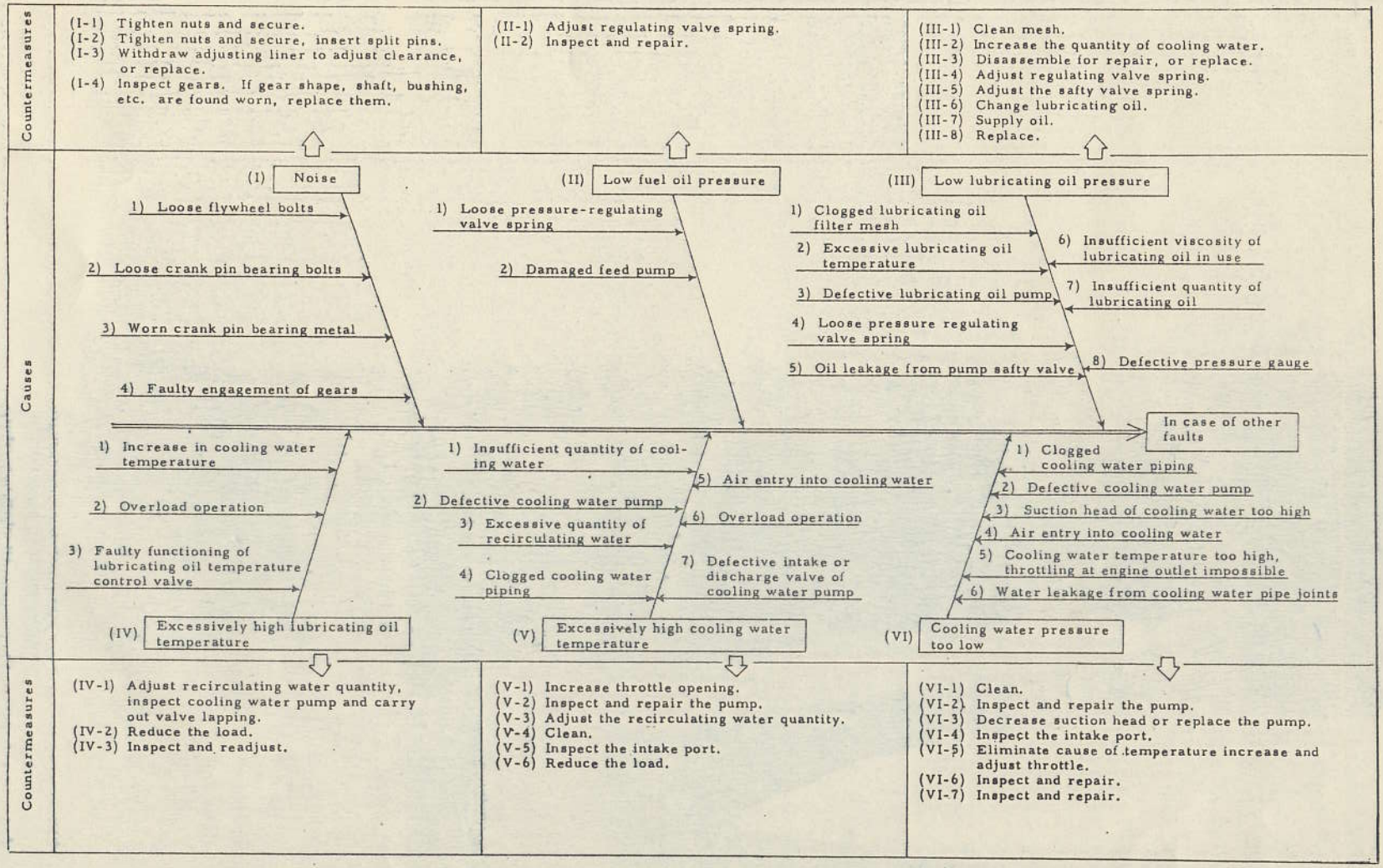


Fig. 9 : In Case of Other Faults



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