

THE MULTI-FUEL ENGINE OPERATOR

YOU REALIZE
OF COURSE, SIR,
THAT UNNECESSARY
IMMERSION OF YOUR
VEHICLE PROMOTES
SEEPAGE OF WATER INTO
SEALS, JOINTS AND
BRAKES !!!... A VERY
DESTRUCTIVE PRACTICE
WHICH WILL RESULT IN
BRAKE OR BEARING
FAILURE.



GROUND MOBILITY

**YOUR
MULTIFUEL-ENGINE
TRUCK AND ...**

YOU

ME?

U.S. ARMY
MUNITION

You might get by with just driving a gasoline-engine truck, but you have to operate your multifuel-engine truck!

So what's the difference? Puh-lenty!

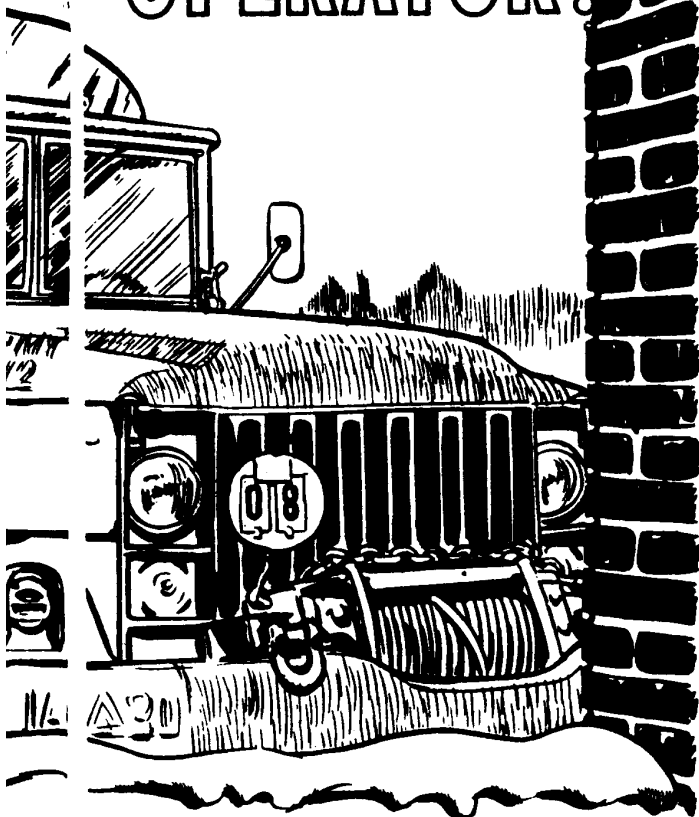
Why, a gasoline-engine truck and a multifuel-engine truck are about as much alike as a cowpony and a race-horse. You don't see much difference from a distance. And even up close, you'll find a lot of the parts are the same. But when you climb into the

saddle—or into the cab—you've got to handle the beast a special way or you won't get the most out of it. You can even ruin it!

So, if you jockey a multifuel-engine truck, forget everything you know about gasoline engines. Scrub it out of your brain. Rap yourself in the head. Take a cold shower. Turn over a new leaf.

You're gonna be a multifuel-engine

DRIVER OR OPERATOR?



truck operator!

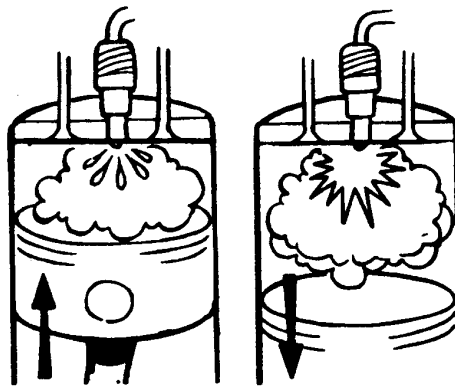
Look at yourself like an airplane pilot moving from prop-jobs to jets. You've got to learn a new way of operating or you'll never get off the ground. Operating your multifuel-engine truck is no where near as complicated as flying a jet plane—but if you don't operate your truck right, you can take off with a brand-new vehicle and come back with a pile of junk.

So let's start fresh. Soak up this info —make like a sponge. Then do right by your multifuel-engine truck —make like an operator.

Here's How it Works-

Your multifuel engine is a diesel (compression ignition) engine. It's got no sparkplugs like the gasoline job. Fuel is ignited by compression. A piston coming up on its compression stroke squeezes the air in the cylinder until it gets hot—real hot. About that time, fuel is "injected" into the cylinder under terrific pressure. The fuel's ignited and burns—giving the power that drives the piston back down on its power stroke.

You can get the fine details on compression ignition in TM 9-8000 (Jan 56), Chap 6, Principles of Automotive Vehicles.



FUEL IS
INJECTED
INTO
COMPRESSED
HOT AIR...

THIS
FUEL-AIR
MIXTURE
IGNITES
AND DRIVES
THE PISTON
DOWN.



YOUR MULTI-FUEL ENGINE HAS A MORE FLEXIBLE APPETITE THAN A "STRAIGHT DIESEL" ENGINE BECAUSE IT'LL RUN ON SEVERAL FUELS BESIDES DIESEL FUEL.

Here's the latest rundown on different fuels you can use in your multifuel engine:

FIRST CHOICE — GREAT
 VV-F-800 diesel fuel
 MIL-F-16884 marine fuel oil
 CITE MIL-F-46005 compression ignition fuel

SECOND CHOICE — GOOD
 Jet Fuel SPEC MIL-J-5624
 Commercial aviation kerosenes Jet A and Jet A-1
 Fuels assigned NATA Symbols F-34 or F-35

LAST CHOICE — SO-SO
 MIL-G-3056 combat gasoline. Considered "emergency fuel," because it doesn't give as good performance as the others in the multifuel engine and, over long use, may shorten the life of a multifuel engine.

4 MULTIFUEL ENGINES — SO FAR

You've got 1 of 4 different multifuel engines in your 2½-ton or 5-ton truck. There may be others in the future, but here're the only ones for now:



— 2½-ton G742-series trucks (M35A1 cargo truck and others in this multifuel family called M44A1-series).



— 2½-ton G742-series trucks (M35A2 cargo truck etc, called M44A2-series).



— 5-ton G744-series trucks (M54A2 cargo truck etc, known as M39A2-series).

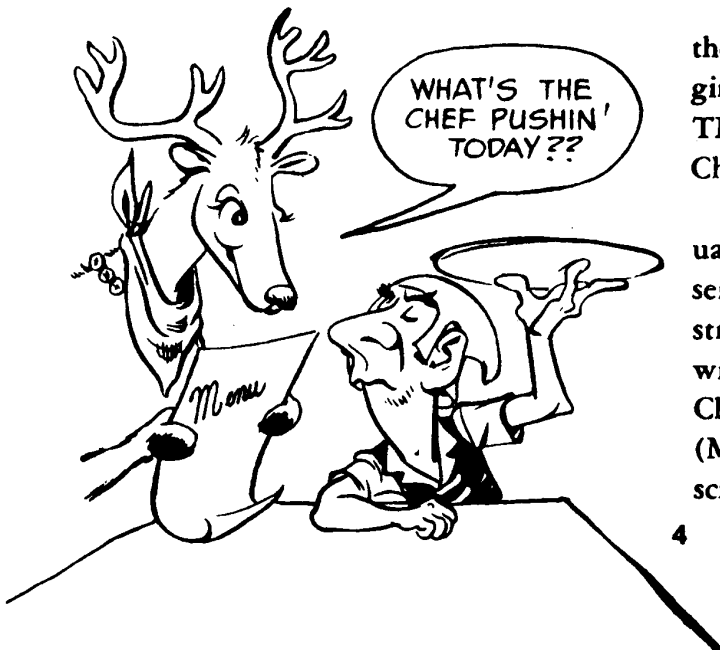


— 5-ton G744-series (also in M39A2-series family).

SAME OPERATOR'S MANUAL

One operator's manual covers both the gasoline-engine and multifuel-engine 2½-ton G742-series trucks. That's TM 9-2320-209-10 with Ch 1 (May 65) Ch 2 (Oct 66) and Ch 3 (June 67).

And there's only 1 operator's manual for all 3 engine-type 5-ton G744-series trucks — gasoline, multifuel and straight diesel. It's TM 9-2320-211-10 with Ch 2 (Jun 64), Ch 3 (Jan 65), Ch 4 (Feb 66, Ch 5 (Oct 66) and Ch 6 (May 67). Forget Ch 1 — it was rescinded.



Engine Scoop

If you want to know more of the "how" and "why" of your engine, borrow a copy of:

TM 9-2815-204-35 (Feb 64)—LDS 427-2 engine

TM 9-2815-210-35 with Ch 1 (May 65), Ch 2 (Jun 66) and Ch 3 (Nov 66)—LDS 465-1, LD 465-1 and LDS 465-1A engines.

By now, if you don't already know, you're askin' what this "LDS" and

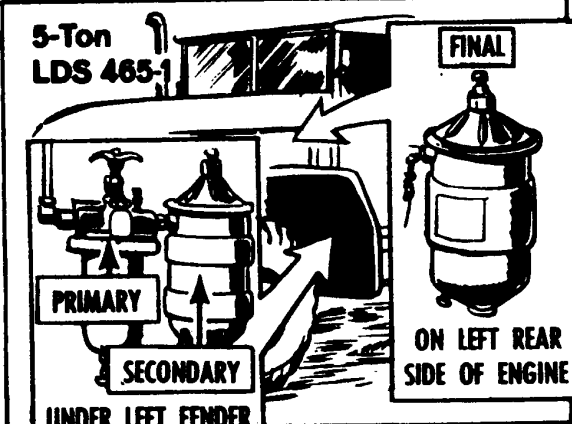
"LD" stand for. Here it is:

L	= liquid cooled
D	= diesel (compression ignition)
S	= supercharged (the LD 465-1 doesn't have a turbosupercharger)

Filter Facts

All 4 engines are pretty much alike as far as operating's concerned. But one important difference is the fuel filter setup. All 4 multifuel engines have 3 fuel filters—primary, secondary and final—but the type of filter and the location is different in a couple of cases.

5-Ton LDS 465-1

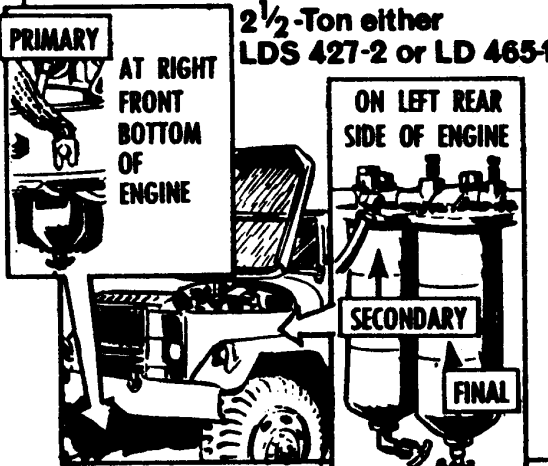


PRIMARY
UNDER LEFT FENDER

SECONDARY
UNDER LEFT FENDER

FINAL
ON LEFT REAR SIDE OF ENGINE

2½-Ton either LDS 427-2 or LD 465-1

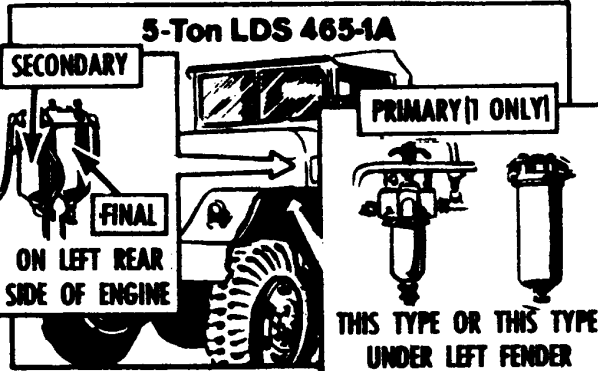


PRIMARY
AT RIGHT FRONT BOTTOM OF ENGINE

SECONDARY
ON LEFT REAR SIDE OF ENGINE

FINAL
ON LEFT REAR SIDE OF ENGINE

5-Ton LDS 465-1A



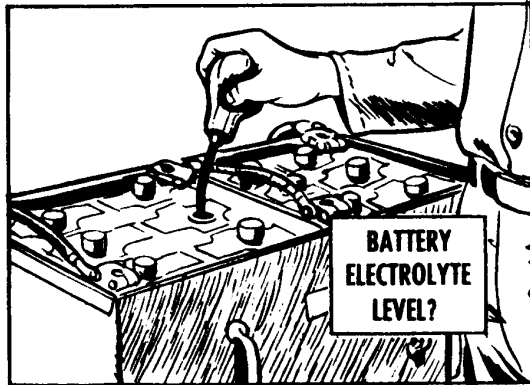
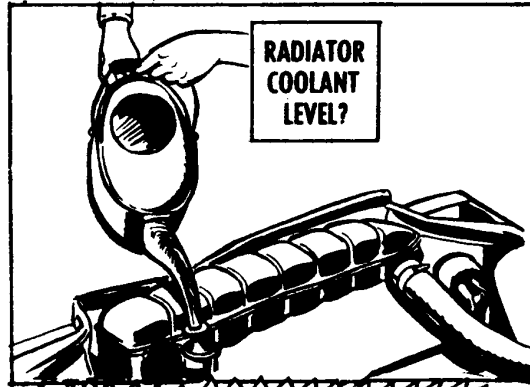
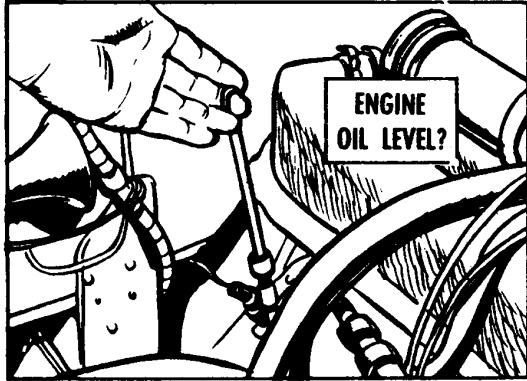
SECONDARY
ON LEFT REAR SIDE OF ENGINE

FINAL
ON LEFT REAR SIDE OF ENGINE

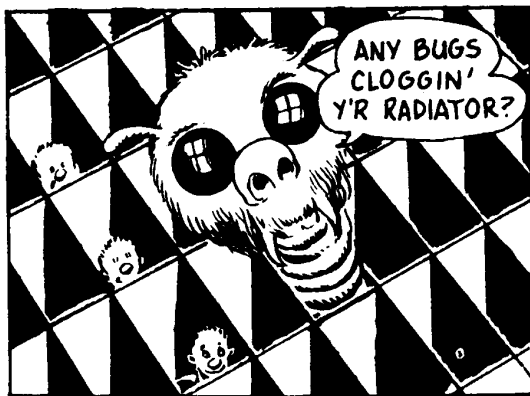
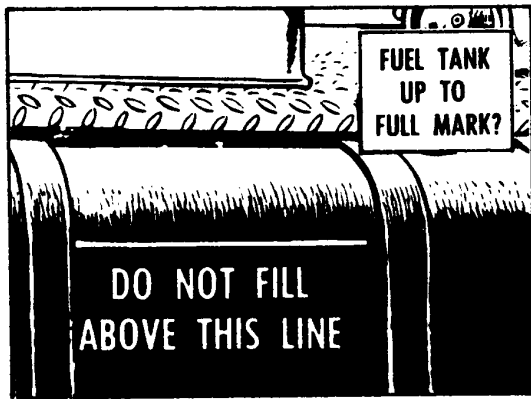
PRIMARY (I) ONLY
THIS TYPE OR THIS TYPE UNDER LEFT FENDER



GETTING



Hot flash, especially for 5-tonners! Check your radiator coolant every time before starting up — even if it's several times a day. Keep that coolant level up!



NOW'RE YOU READY TO START OPERATING LIKE A PRO? HOW ABOUT YOUR WALK-AROUND CHECK?



Leaks? Either lube or coolant? Check hoses, fittings, connections. Wet spots on ground?

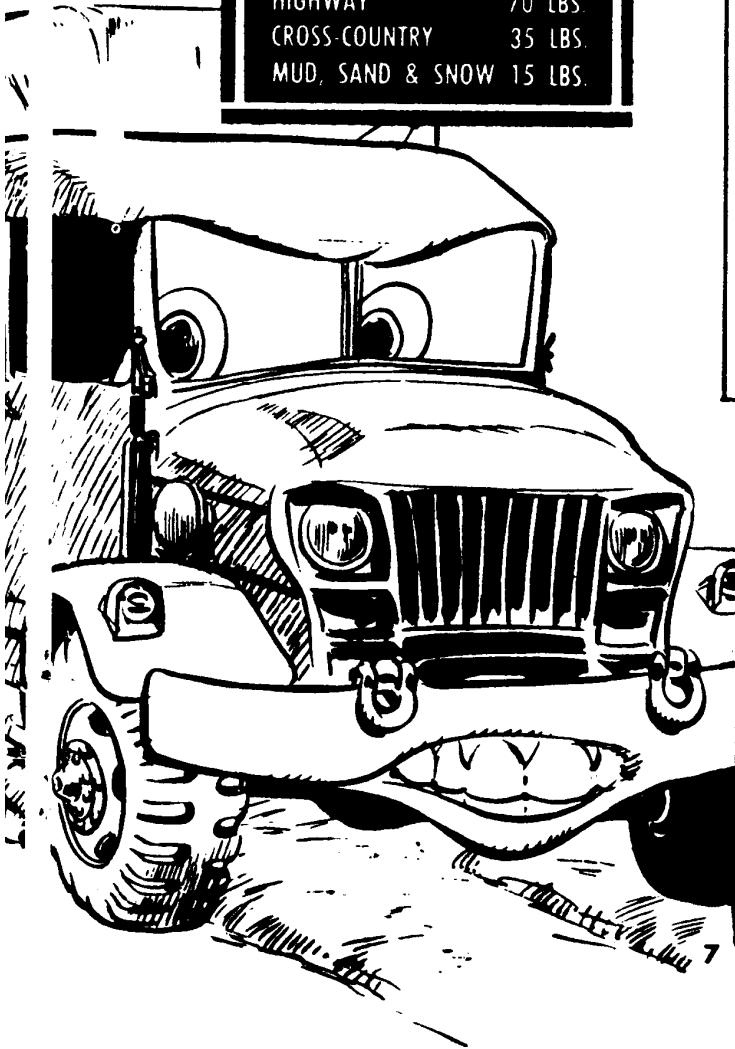
READY...ooo

Hold it! Before you settle down behind your steering wheel—drain your primary fuel filter.

This's where you start separating the ordinary drivers from real operators. Your multifuel engine's not too fussy about what kind of fuel you feed it, but it's mighty touchy about quality—no dirt or water or, like you find in the tropics, fungus.

TIRE INFLATION PRESSURES

HIGHWAY	70 LBS.
CROSS-COUNTRY	35 LBS.
MUD, SAND & SNOW	15 LBS.

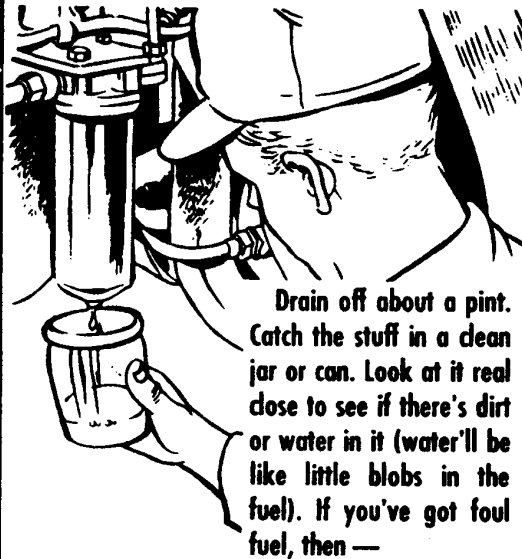


So this's an absolute must before you fire up:

1. Turn on your accessory switch so the in-tank fuel pump will run.



Now open the drain cock on the bottom of your primary fuel filter (on scraper-type, give the handle on top of the filter 2 complete turns before draining to loosen any junk on the filter element).



Drain off about a pint. Catch the stuff in a clean jar or can. Look at it real close to see if there's dirt or water in it (water'll be like little blobs in the fuel). If you've got foul fuel, then —

2. Drain your secondary filter. Check this carefully too. If it's got water or junk in it, go on and —

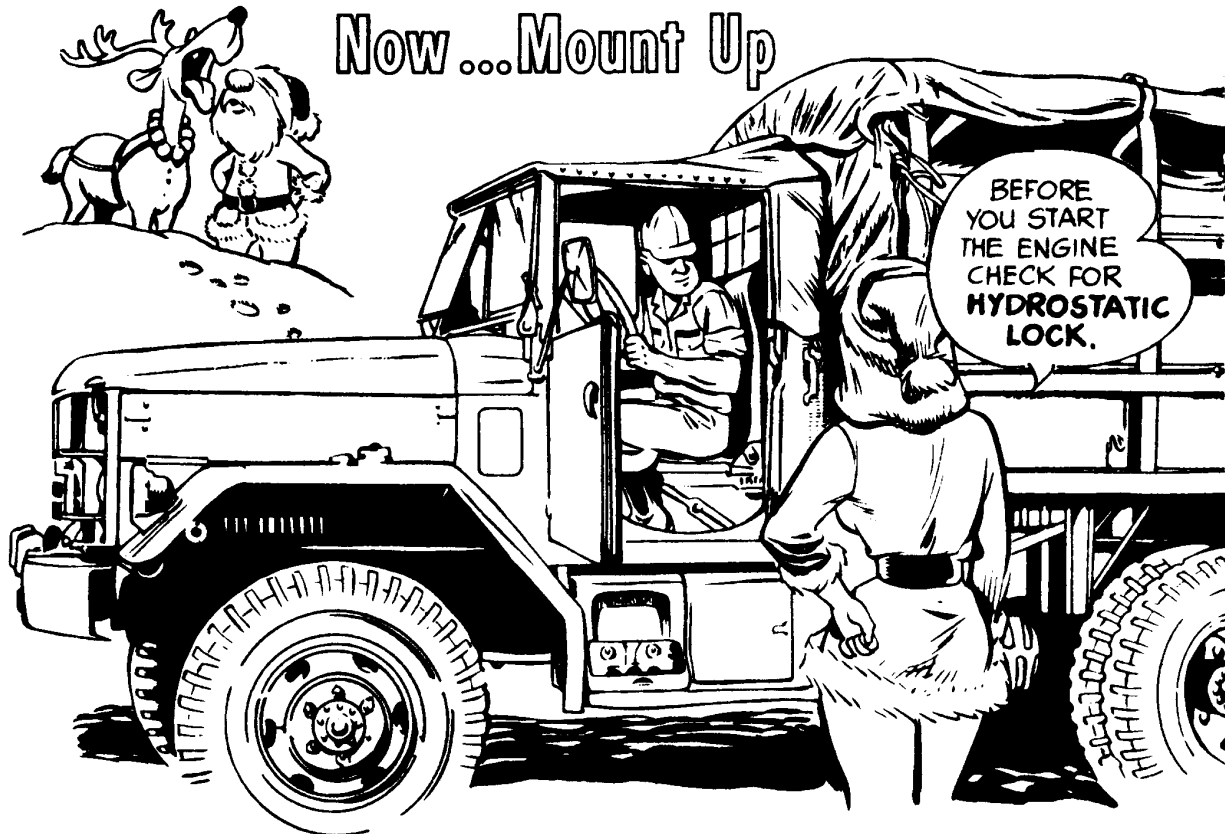
3. Drain your final filter. This's where things get hot—any foreign stuff getting through your final filter can ruin a mighty fancy little piece of machinery called the "fuel injector pump."

MEDIC!



So you've got a bad case of contaminated fuel if there's water or dirt in your final filter. Get a mechanic to service all 3 fuel filters — cleaning and replacing filter elements.

PS MORE



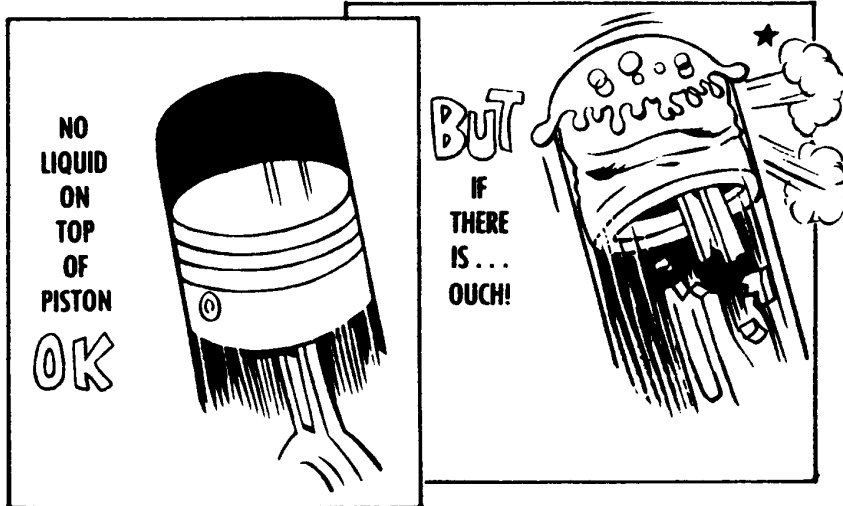
Now...Mount Up

BEFORE YOU START THE ENGINE CHECK FOR HYDROSTATIC LOCK.

Climb aboard. But you're not quite ready to start up your engine yet — not till you've checked 'er out for hydrostatic lock. If you forget this just once, you could wind up with a hunk of pretty useless iron in your engine compartment.



THIS IS WHAT HAPPENS!



NO LIQUID ON TOP OF PISTON
OK

BUT IF THERE IS... OUCH!

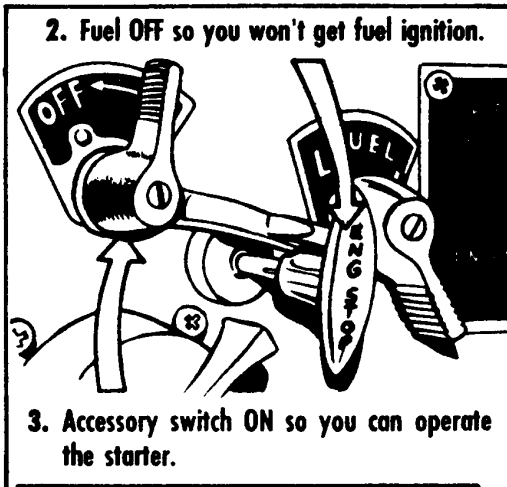
Hydrostatic lock happens when there's liquid — fuel or water — sittin' on top of one or more of the pistons. This's like rock when your piston rams it up against the cylinder head. It can ruin an engine — or at least bust a connecting rod.

Here's How To Check For Hydrostatic Lock

1. Gearshift in **NEUTRAL** and handbrake **ON** (they're supposed to be that way anyhow from when you parked your truck).



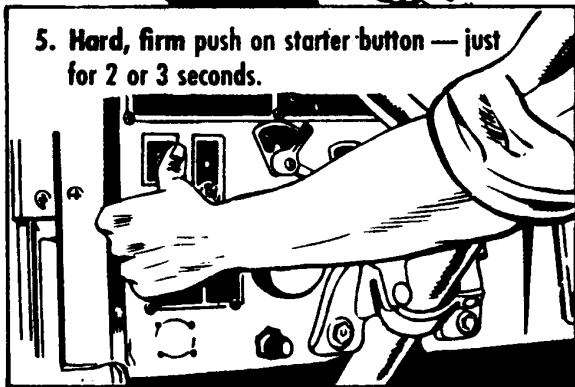
2. Fuel **OFF** so you won't get fuel ignition.



3. Accessory switch **ON** so you can operate the starter.

4. Push clutch pedal to floor.

5. Hard, firm push on starter button — just for 2 or 3 seconds.



Listen close and feel for a hard thud in the engine as you turn 'er over. Or maybe it starts turning over and quits with a thunk. Or maybe it won't turn over at all.

Take your finger off that starter button **right now** if you get any one of those signs of hydrostatic lock. Your mechanic will check it out. He may have to drain fuel or water from the cylinders and find out how it got in there.

Now, Start Up!

This time you turn 'er over with fuel **ON**. Clutch pedal down again. No more than 30 seconds on the starter button — 10 seconds is usually enough.

REMEMBER
HARD AND FIRM
ON THAT STARTER
BUTTON.

... so you don't burn out the switch and maybe cause trouble in the starter to boot.



Wait at least 2 minutes if she doesn't take off — then try again. If your multifuel engine won't start in 3 tries, give it up and call a mechanic.




Never pump the accelerator pedal on a multifuel-engine truck. It doesn't do any good and it can do a lot of harm.

Also taboo is trying to start a multi-engine truck by towing or pushing. You might have missed some sign of hydrostatic lock. Towing would force your engine and could bust it. So use jumper cables if your engine needs a boost.

1

AFTER STARTING ENGINE RUN AT LESS THAN 1000 RPM FOR 5 MIN TO PREVENT DAMAGE TO TURBOCHARGER

BETWEEN 800 AND 1000 RPM

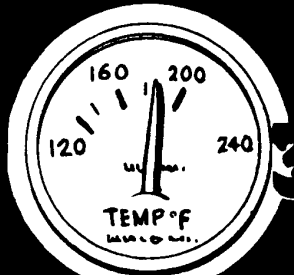


'N Warm 'Er Up

Idle for 3 to 5 minutes or until engine heat reaches 120°. Engine speed should be above 800 RPM but under 1000 RPM. Idling too slow sets up vibrations that'll loosen some parts and even break others. This warmup helps the whole engine, but it's especially important for your "turbocharger" (turbosupercharger). Exhaust gas spins your turbocharger at about 30,000 RPM at idle speed and up to 60,000 RPM at operating speed. Idling gives oil a chance to get to it at low speed. Never stomp on pedal or overspeed engine.

2

3

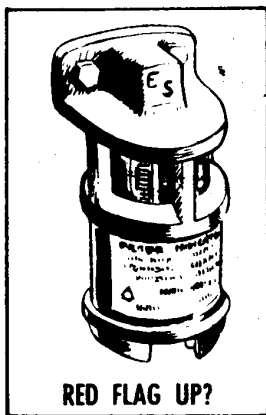


EASY TILL YOU GET ABOUT HERE...



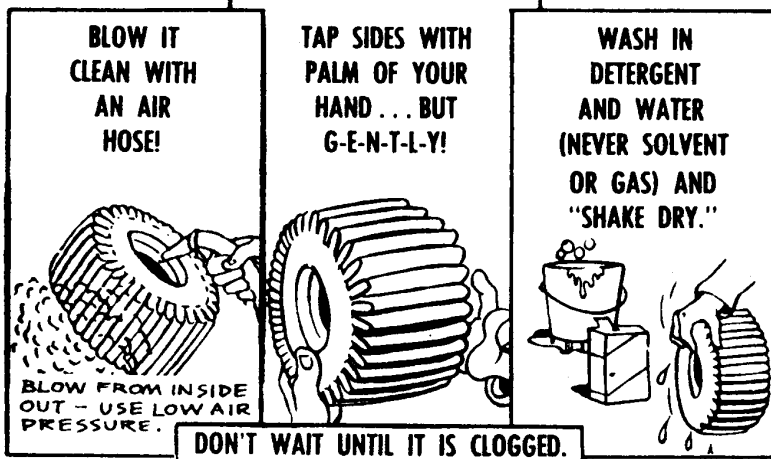
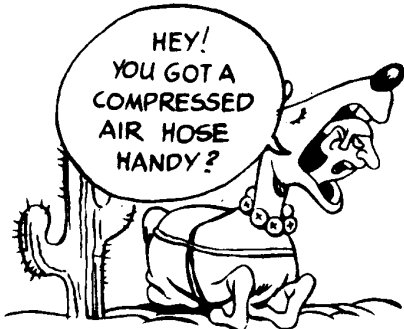
Watch your oil pressure gage close for the first 20 seconds of idling. If it doesn't go up to 15 PSI at 800-1000 RPM, shut down quick and holler for a mechanic—you've got a sick engine.

Engine coolant temperature should be up to 120°F before you think about hittin' the road. It'll move up faster when you get rolling. But take it easy even then, until your engine temp works up to between 170° and 200° before giving 'er full throttle and full load. And never operate with your hood side panels open—you'll just goof up the way cooling air is supposed to be channeled through your engine compartment.



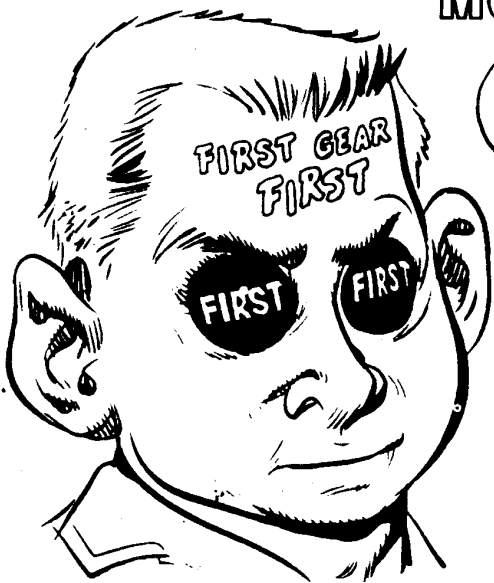
Heavy, black exhaust smoke? Engine popping and missing? Power pooping out? These're signs your air cleaner filter element may be clogged up and needs cleaning—pronto! Check your air cleaner indicator—the red flag up over half-way means your filter element's in bad shape dirt-wise. Shut down and clean it.

In dusty country your filter element needs cleaning every day.



Eyeball your other gages and indicators. Make sure your air pressure warning buzzer has quit (how could you miss it?) before you —

Move Out



SHIFT GEARS IN PROPER SEQUENCE!

Scratch this on your skull or paint it on your eyeballs, if you have to, but remember — **FIRST gear first.** You don't want the name of Luggin' Louie.

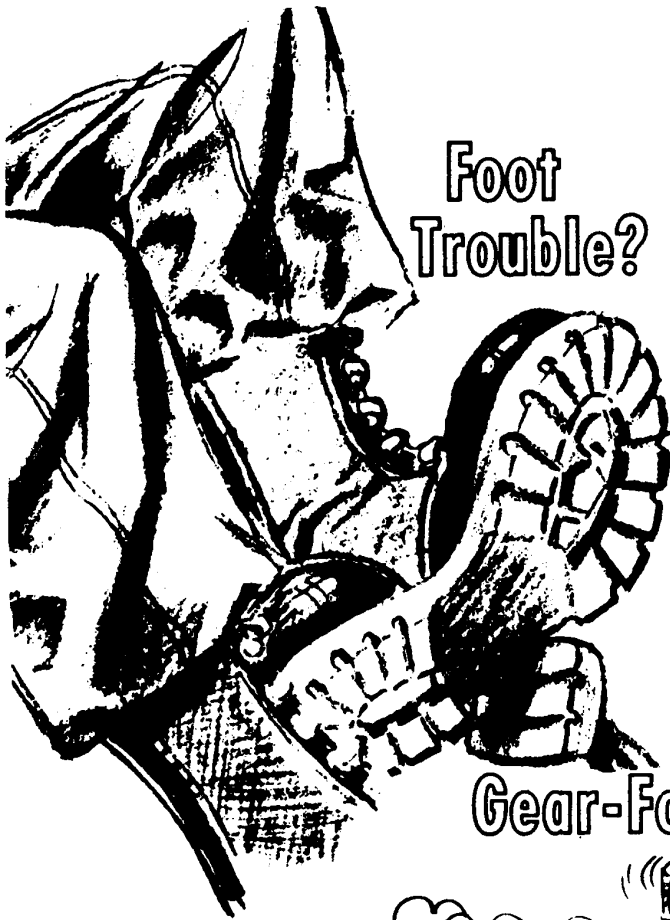


Lugging is that vibration, shuddering and shaking you get when you're operating your vehicle in too high a gear for the speed you're traveling. Lugging — in any gear at any speed — is about the worst thing you can do to that beautiful piece of machinery under your hood. (Comin' up, under Tach Talks, is a special chart on RPM limits.)

Remember, when you take off from a standstill, there's no other choice for a forward gear but **FIRST**.

Now engage your clutch smooth and easy while you feed 'er fuel. This's no hotrod, dragster or sports car. You've got anywhere from 10 to 20 tons or more to move out — depending on whether your truck's loaded or light.

So no clutch-popping — in any gear.



Foot Trouble?

Now, f'rgoshsakes, get your big apple-mashin' foot off that clutch pedal and leave it off — until you've got some good reason for working the clutch. No operator uses the clutch pedal for a footrest.

Clutch-riding is the same as not having enough clutch free-travel. Parts of the clutch that're supposed to be sittin' still are goin' like crazy all the time and wearing out long before they should. And you're not getting good, solid contact between your clutch and engine — a fast butchering job on your clutch facing. So — no clutch-riding.

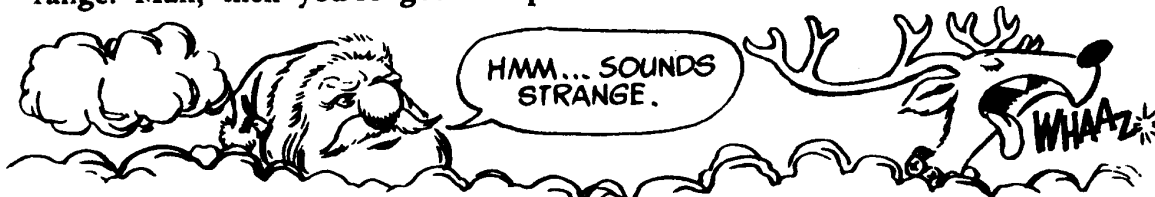
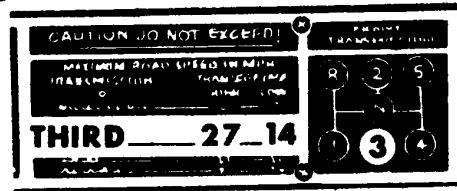
Gear-For-Speed



If you've got a tin ear and a wooden leg, so you don't know when your engine's lugging, then pay close attention to your speedometer and your data plate on transmission gear and transfer case range for speed.

F'rinstance, say you're doin' about 25 MPH in a 2½-ton multifuel job. And you've got 'er in 4th gear, high range. Man, then you're goofin' up!

Because your data plate says you should be in 3rd gear at that speed. But you should be able to tell just by the feel of your truck — shuddering and bucking and tryin' to shake itself to pieces.



You can go too far the other way too — driving at high speed in low gear. This makes the engine turn over a lot faster than it has to. Your engine wasn't built to purr like a kitten — or even a tiger — but you can tell the difference between a nice, steady rumble and a howlin' roar.

Poor power on a hard pull could mean your fuel injector pump's on the fritz, your support will have to straighten 'er out.



Tach Talks

TOP RPM LIMIT UNDER-LOAD FOR BOTH 2½-TON AND 5-TON MULTIFUELS IS NOW 2600. THIS'S OPERATOR-CONTROLLED. MAKE SURE YOUR DANGER ARROW DECAL HAS ITS TAIL AT 2600 RPM.



There's a new no-load RPM limit for 5-ton multifuels. Maximum no-load RPM is 2900. Check yours—with transmission in NEUTRAL. Bring 'er up slowly to full throttle. If your tach goes over 2900 RPM, get your support to readjust your fuel injector pump so top RPM is between 2800 and 2900 RPM.

Here's the "what" and "when" on RPM limits under-load (operator-controlled) for 2 ½-ton and 5-ton multifuels:

MULTIFUEL ENGINE RPM'S CONTROLLED BY OPERATOR

	2½-TON	5-TON
A	1200	1400
B	1400-to-1800	1600-to-1800
C	1400-to-2200	1800-to-2400
D	2600	2600

A = Lowest engine RPM for operation "under load" — that's when your engine's pulling steady to make your truck travel.

B = Lower RPM figure is best for downshifting. Never downshift when your engine RPM is over the higher figure.

C = For normal cruising operation. Between these 2 RPM figures will give you the most miles per gallon of fuel.

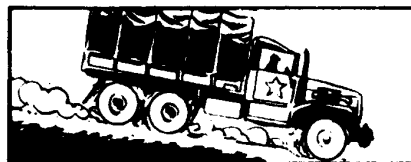
D = Absolute top RPM for operating under load. This's about what you'll rev your engine up to when you're hauling a heavy load up a steep hill. There should be a red DANGER arrow on your tachometer face glass with the tail right at this RPM mark. You're askin' for trouble if you let your tach needle slip past the arrow's tail. (FSN 7690-999-7807).

DOWN, BOY, DOWN

SHIFT DOWN FOR HILLS—BOTH UPHILL AND DOWNHILL!



You shift to a lower gear for an uphill pull to get more power, natch. Your engine turns over faster (higher RPM) and you don't get lugging—if you shift down soon enough. Get the feel of your truck so you shift down before she starts lugging. And watch that RPM limit (Column B in the chart) for downshifting.

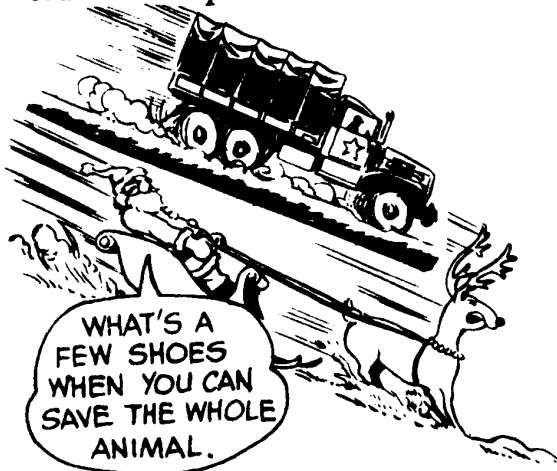


Downshifting for downhill travel helps put a drag on your speed. Here's where a real operator shows his fine tuning. Here's where your RPM can get away from you if you're not hot on the ball. Keep one eye glued to your tachometer. Drop 'er into the right gear range and control RPM by using your brakes.



But Give 'Er A Break

Use your foot brake to hold back your downhill speed—downshifting isn't enough. Brake lining is a heckuva lot cheaper and easier to replace than your engine and other parts that can be wrecked by overspeeding. Turning over at too high an RPM can make your engine just fly apart inside. Those finely machined parts in your fuel injector pump will go to pieces. Your heavy flywheel could blow up like it was blasted with TNT.



But pump your brakes when you use 'em going downhill so you don't overheat the brake linings and brake drums. Smoke 'n' fire pourin' out of a wheel is kind of a hint that you went to sleep on your brake pedal.



**PUMP IT!
RIDING THE BRAKE
WILL BURN UP
YOUR LININGS
BUT FAST!**

Braking is real important, too, when you go to your transfer low range to get more gear ratios. Shifting your transfer case from HIGH to LOW range doubles your engine RPM without changing your truck's speed. This means you've got to make sure your engine RPM is down to 1200-1300 when you shift from HIGH range to LOW range. So you've got to get your foot brake into action to slow down enough to shift.



**TEAM UP BRAKES AND DOWNSHIFTING
... THAT'S OPERATING, MAN!**

But, puh-leeze, no downshifting to slow down for a stop. Even if you don't happen to over-rev your engine with this kid stuff, you throw your 10 or 20 tons of truck and cargo weight on your engine and clutch. No good! Let up on the fuel pedal when you see you're going to stop. Then use steady pressure on your brakes to come to a stop. No brake pumping here, though—you won't have to worry about overheating your brakes if you let the truck slow itself down some before you go to the brakes.

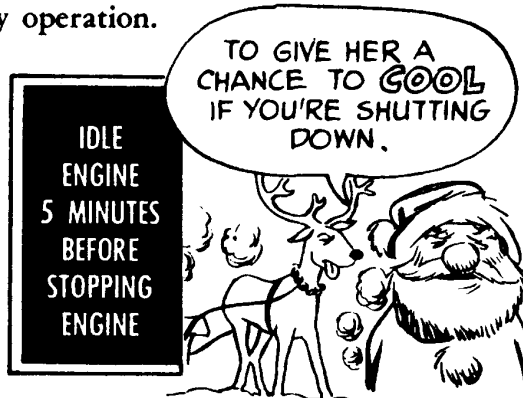
Lay off slipping the clutch when you're stopped on an uphill grade. It's even worse than riding the clutch. Some truck-butchers keep 'er in gear and then hold the clutch pedal part way down so the engine will keep the truck from rolling back. Clutch slipping—no good.

Idling And Shut Down



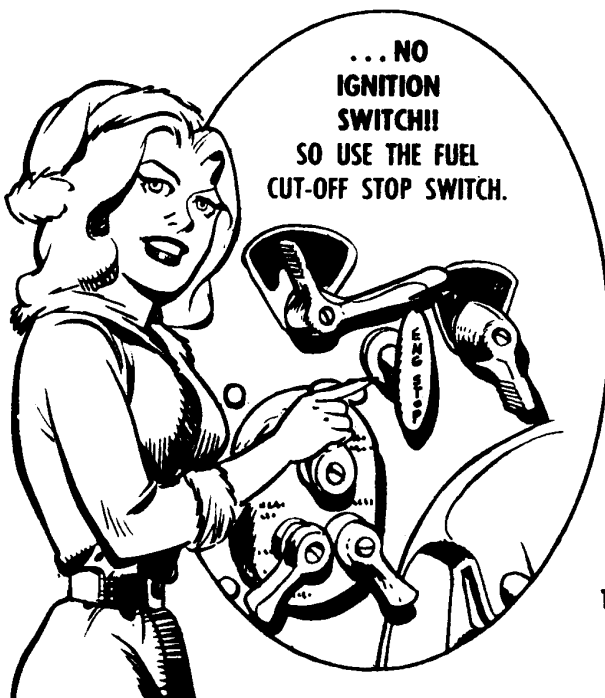
Keep your engine running—idle between 800 and 1000 RPM—for short stops. Figure a short stop is anything up to 30 minutes. You don't do your multi-fuel engine any favors by shutting down and starting up again all the time. It works better and lasts longer under steady operation.

Before you do shut down, always run your engine at the same idle speed for 5 minutes. Shutting down too soon doesn't give your cooling system a chance to take the top off that terrific engine heat. Fact is, a quick shutdown will make your cooling system's normal operating heat and pressure shoot up like a rocket!



Idling before shutdown is important for your turbocharger too. It's lubricated by your engine's oil system. A quick shutdown cuts off this oil supply while the turbocharger's still spinning at about 60,000 RPM—it could burn up at that speed without lube. Idling gives it a chance to slow down.

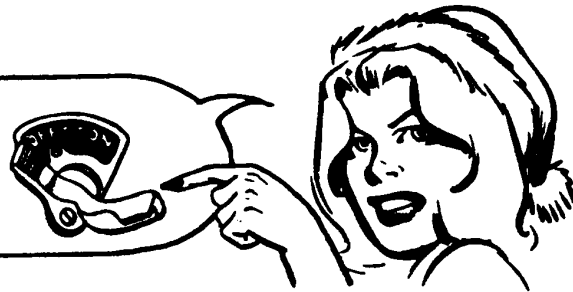
Remember The Switch!



No, that's right, there's no ignition switch on your multifuel-engine truck. Your engine STOP cuts off the flow of fuel to your engine—with no fuel, there's nothing to burn. If your STOP control fizzles out on you and won't cut off the engine, here's an emergency way to stop your engine:

With brakes ON and transmission in highest gear, let out the clutch and stall the engine.

TURN OFF THE ACCESSORY SWITCH WHEN YOU SHUT DOWN!



But remember that accessory switch when you shut down. Turn it off. Forgetting to turn off the accessory switch is one of the main causes of hydrostatic lock. Your in-tank fuel pump keeps running and pushing against fuel in the lines. This can push fuel past your manifold heater valves and on into your cylinders—a perfect setup for hydrostatic lock.

Besides, if you forget to shut down your electrical system, you'll likely find your batteries pooped out when you're ready to go again.

Wrap-Up

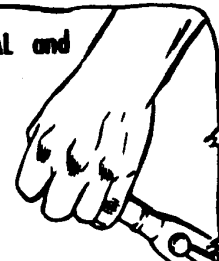


YOU'RE NOT DONE YET!



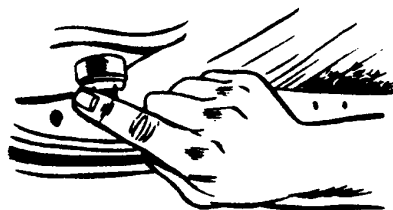
Parked on a slope? Front wheels turned into the curb, if there is one, or rocks or a log in front of the wheels.

Gearshift in **NEUTRAL** and handbrake **ON**.

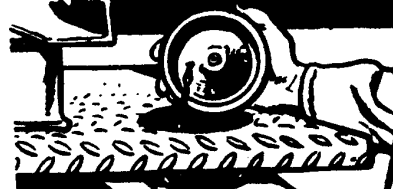


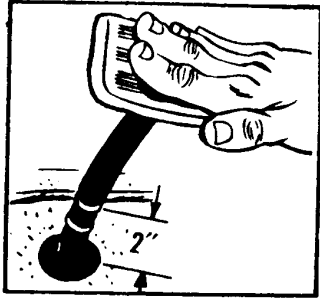
Danger: Never leave 'er in gear. If your truck gets nudged, she could start up and roar off.

Drain your air reservoirs.



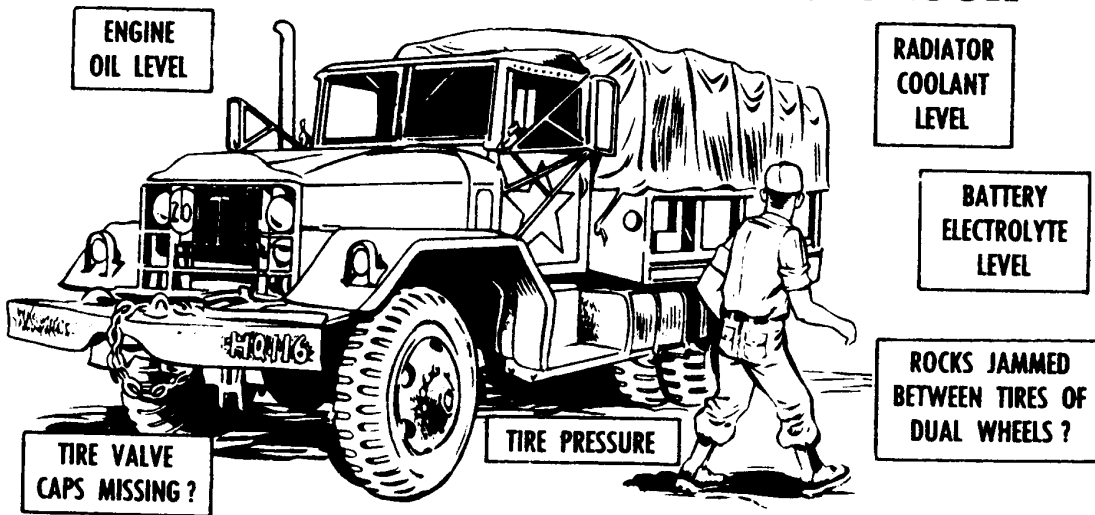
Fuel tank up to the **FULL** mark. This cuts down on space in the tank where moist air can condense and foul your fuel.





This's a good time to check your clutch free-travel. Do it at least once a week—it's easy and takes only a second if you've got your clutch pedal shaft marked. Free-travel has got to be at least 1½ inches but no more than 2 inches. Just a fraction off these limits can mean a sure and early death for your clutch. If your clutch free-travel's off, get a mechanic on it quick.

Last Minute Walk-Around Check



Make this last minute walk-around check a habit. It could be a life-saving habit—not just for your truck's life but for your own. You may have to roll out in a hurry and move out fast. When you're 'way out in the middle of nowhere and things are hot is a bad time to find out your vehicle needs something you should have given it before you took off.

Now, man, are you just a truck driver or are you a real pro—a

**MULTIFUEL ENGINE
TRUCK OPERATOR?**



THE PROFESSIONAL

A man to be respected
for his SKILL and KNOWLEDGE



The Multi-Fuel Engine
Truck Operator

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and Learn
WHY