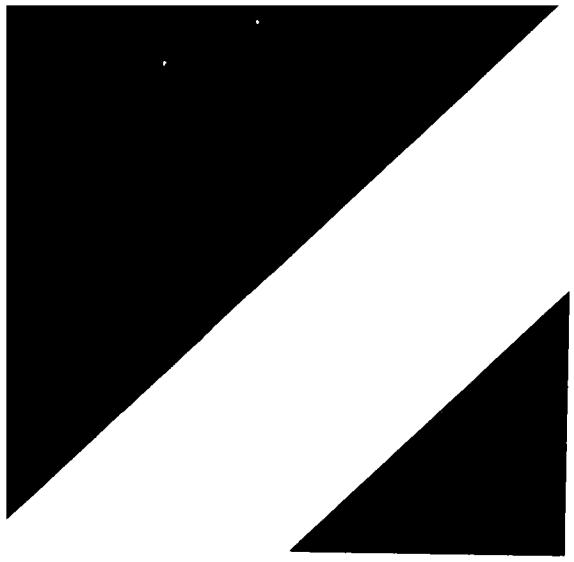
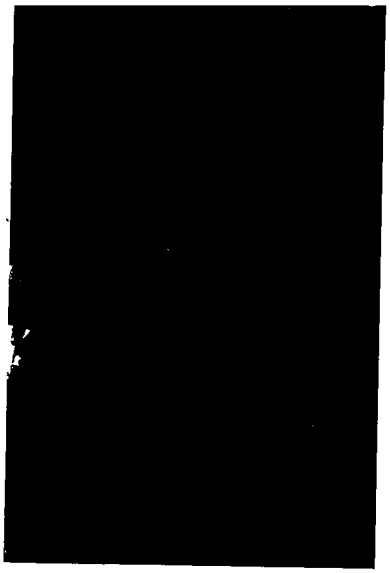
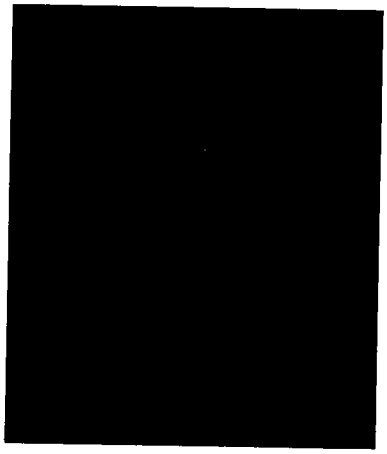




NAME_____
CLUB_____
BIRTHDATE_____
YEARS IN PROJECT___
YEARS IN 4-H ___



PETROLEUM POWER PROGRAM

TRACTOR 3

Improving Your Skills

CO 677

THE 4-H TRACTOR CARE AND SAFETY PROGRAM

THIRD YEAR — TRACTOR PROJECT

Units

1. **Tractor Safety on the Highway**
2. **Engine Ignition Systems**
3. **Hitches, PTO, and Hydraulic Controls**
4. **Steering, Brakes, and Front Wheels**
5. **Valves and Valve Service**
6. **Power Transmissions**
7. **Winter Care and Trouble Shooting**
8. **Tractor Records and Ownership Costs**

FOURTH AND ADVANCED YEARS — MACHINERY PROJECTS

Units

1. **Safe Use of Farm Machinery**
2. **Transmitting Power**
3. **Tools For Breaking The Soil**
4. **Applicators For Chemicals**
5. **Servicing Seed Planters**
6. **Cutters for Crops**
7. **Seed Separation**
8. **Farm Machinery Management**

IMPROVING YOUR SKILLS

This is the third in a series of four project books in the 4-H Tractor Program. It is intended for your use after you have completed the First and Second Year Project books. By doing the demonstrations and jobs outlined, you will learn more about tractor care and safety.

The purpose of the 4-H Tractor Program is to give you an opportunity to "learn by doing." You will learn that better tractor care results in longer tractor life, more power, and lower operating costs. Because you learn how to do many small but important tractor maintenance jobs, you will get better production from farm power units and you will cut down on costly breakdowns.

While you are learning how to care for your tractor you should also learn how to be a safe operator. Another important goal of this program is to help you form good safety habits so that you can think and act safely—at all times.

Equally important with learning tractor care and safety is the 4-H goal of helping you to become a sound-thinking citizen. The training you receive in your 4-H program will be very beneficial to you throughout your lifetime.

Take time to read carefully the informative material in each unit. Go through the work units slowly and carefully, and complete the demonstrations and jobs outlined. The greater the interest and effort you give to your 4-H project, the greater will be its reward to you.

Ask your leader about Unit 8 on record keeping and ownership costs. He may want you to start on this unit right away.

ACKNOWLEDGEMENTS

This educational material has been developed for 4-H use by the National 4-H Petroleum Power Program Development Committee, composed of representatives of the Cooperative Extension Service of the State Land-Grant Universities and the U.S. Department of Agriculture, Amoco Foundation, Inc. and the National 4-H Council. Special appreciation is given to Extension Agricultural Engineer Richard D. Goodding, II., University of Nebraska, for current revisions, to Amoco Foundation, Inc. for financial assistance in the preparation of this manual published by the National 4-H Council. Illustrations on pages 4, 5, 6, 7, 8, 9, 10, 21 courtesy of John Deere Service Publications.

25-2-77/50-2-78

MEMBER'S SUMMARY

THIRD YEAR

TRACTOR CARE AND SAFETY

Name _____ Age _____ Years in 4-H _____

Address _____ County _____ State _____

Name of Club _____ Name of Leader _____

Date and Place of Meetings	1. Tractor Safety on the Highway	2. Engine Ignition Systems	3. Hitches, PTO, and Hydraulic Controls	4. Steering, Brakes, and Front Wheels	5. Valves and Valve Service	6. Power Transmissions	7. Winter Care and Trouble Shooting	8. Tractor Records and Ownership Costs	
1.									
2.									
3.									
4.									
5.									
6.									
Date meeting held									
Did you attend?									
Date work unit completed									
Date check-up sheet completed									

DEMONSTRATIONS: Where? When? Topic? _____

TRACTOR OPERATING CONTESTS: Date? Where? Placing? _____

OTHER EVENTS: Exhibits, Tours, etc. _____

TRACTOR SAFETY ON THE HIGHWAY

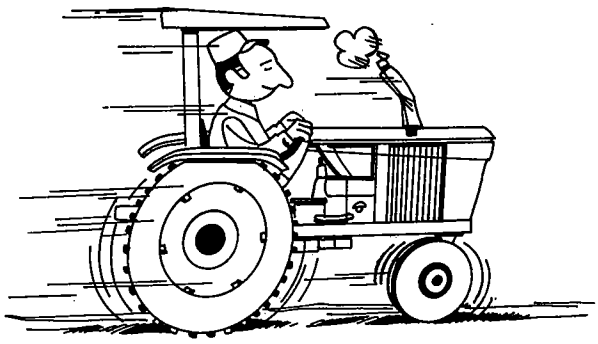


Fig. 1 Tractors are not designed for highway travel.

About one-half of all fatal tractor accidents occur on highways, county road and other roadways. Collisions with other motor vehicles are an important cause of death, but a large number of the fatal tractor accidents involve only the tractor.

Inexperienced operators, unsafe operation, not watching the road, and excessive speed are common causes of tractor accidents on roadways.

TRACTORS ARE NOT BUILT FOR HIGHWAYS

Your tractor was not designed for use on highways and public roads. The road speed of a tractor is much slower than that of an automobile or truck. A tractor traveling at less than 20 mph is a "sitting duck" for an automobile or truck traveling at 55 mph. It only takes an automobile 7 seconds to travel 410 feet to overtake a tractor traveling at 15 mph.

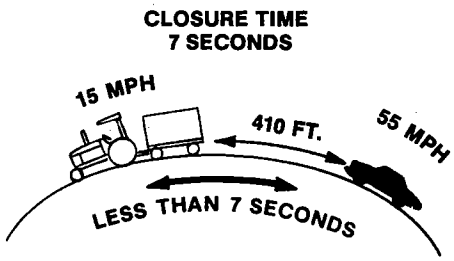


Fig. 2 Tractor and car: driver has less than 7 seconds closure time to tractor.

Tractors also have a high center of gravity which makes them easier to overturn if turned sharply while traveling at excessive speeds, if an obstruction is hit or when accidently driven into the road ditch.

The quick acting power steering on tractors requires the full attention of the driver while he is traveling at higher speeds. The tractor is designed for rapid maneuverability at low speed, not high speeds. This is why many accidents have occurred when the driver looked to the rear and accidently turned the steering wheel slightly as he looked back thus causing the tractor to swerve into the road ditch.

Tractors are not made to carry passengers. For this reason carrying passengers on the tractor is a dangerous practice. Other arrangements should be made to give rides to extra persons.

Tractors are being used to pull larger and larger loads on highways. Wagons and trailers capable of carrying up to 12 tons of hay or grain are frequently being pulled by farm tractors.

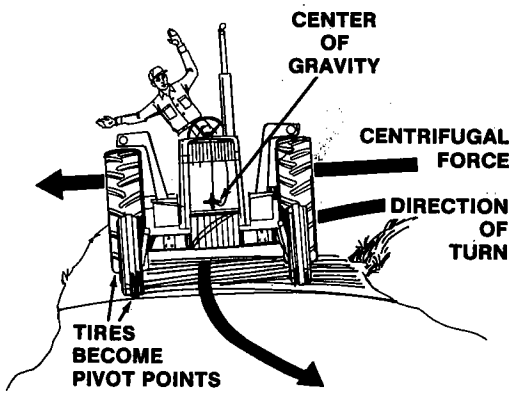


Fig. 3 Side tips are aggravated by dynamic forces acting on a tractor in a turn.

TRACTOR SAFETY ON THE HIGHWAY

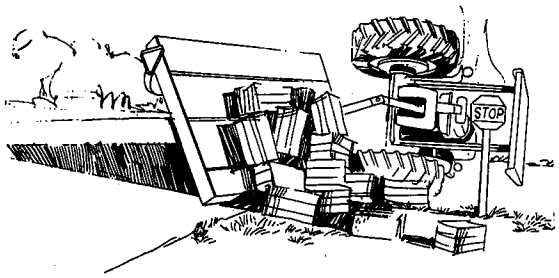


Fig. 6 You can't make a quick stop when pulling a load.

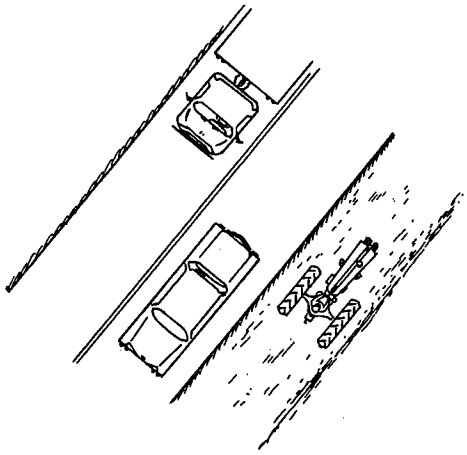


Fig. 7 Drive on the shoulder.

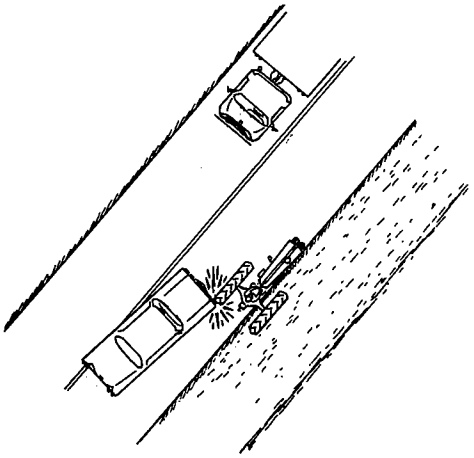


Fig. 8 A dangerous practice that can lead to accidents.

Heavy loads hitched to a tractor traveling at road gear speeds easily create steering and braking problems. Especially when the tractor is pulling the load downhill or under conditions when the shoulder is soft or if loose gravel is present. Remember the tractor has only two brakes, one for each rear wheel and the heavy machine or wagon being pulled has no brakes at all.

STATE LAWS RELATING TO FARM EQUIPMENT

There are certain laws in your state that apply to the operation of farm equipment on public roads. These laws cover the operation, lighting, and identification of farm equipment on public roads and vary from one state to the next. To obtain the information on the laws that apply to your state, check with your local state police. Perhaps they can furnish you with a copy of the traffic laws for farm equipment. This information would make a good report for your next club meeting.

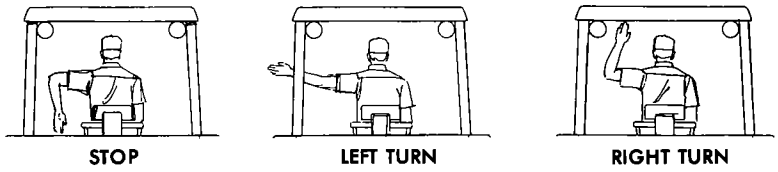


Fig. 4. Standard turn signals warn other drivers of your intentions.

Fig. 5. Traffic operators must heed all signs and traffic laws.

SAFE DAYTIME DRIVING

Avoid the use of busy highways even if it means you must drive somewhat out of your way. If you have to use a two-lane highway, drive on the shoulder if possible and go slowly enough to see obstructions or holes that could cause an upset. Sometimes you have no choice but to use the highway surface. When you do, avoid the dangerous practice of driving with one wheel on the pavement and the other on the shoulder. This practice encourages faster traffic to try to pass when there isn't enough room. If oncoming traffic doesn't yield part of its lane, the car attempting to pass will crowd the tractor off the highway or side-swipe it, catching the left rear wheel. It is better to occupy one full lane the same as if you were driving a car. At least this will help to keep cars from passing you without first making sure there is no oncoming traffic.

Hilly, winding roads are especially hazardous because the driver of an oncoming vehicle cannot see you and you cannot see him. As a result there may be a collision or someone has to take to the ditch.

TRACTOR SAFETY ON THE HIGHWAY

The best way to avoid highway accidents is to stay off the road as much as possible. If you must use the highway, use it when traffic is the lightest, and make your equipment as easy to identify as possible.

All states now require by law that a slow-moving vehicle (SMV) identification emblem be placed on the rear of any tractor, tractor with towed equipment or self propelled machine traveling 25 mph or slower.

The SMV emblem consists of a flourescent yellow-orange triangle with a dark, red reflective border. The yellow-orange triangle is for daylight identification and the red border is for night identification. The emblem should be attached to the center of the equipment and between 2 to 6 ft (0.61 to 1.83 m) above the ground measured from the lower edge of the emblem. The SMV emblem may be permanently attached or portable for use with several implements.

SMV emblem shall not replace such warning devices such as tail lamps, reflectors, flashing lights, or warning flags, and it is not to be used as a clearance marker for wide equipment.

The SMV emblem needs to be replaced as it begins to fade or it will not offer protection for the tractor operator or for the motor vehicle driver from an accident.

PRACTICE COURTESY

Safety on the highway begins with courtesy. When traffic piles up behind you, pull off the road at the first opportunity and let it pass. Remember that it is a privilege for you to operate your tractor and equipment on a highway. Don't abuse this privilege. Practice courtesy. Know and obey the rules of the road as they apply to the tractor and other slow-moving equipment in your state.

SAFE DRIVING AT NIGHT

Operating your farm equipment on a highway at night presents a serious problem since it is difficult for motorists to know of your presence. The best rule is to stay off the highway at night with slow-moving equipment. Plan your work so that your equipment is moved during the daylight hours and at a time when traffic is lightest.

If you must travel at night, be sure your tractor is provided with adequate lights, and that supplemental lighting is provided for the towed equipment. Your local state laws should be followed in the lighting of your equipment. You may find that they are similar to the laws suggested by the Uniform Vehicle Code. This Code states that tractors should have one or two white lights visible 500 feet forward, and a red light visible 500 feet to the rear.

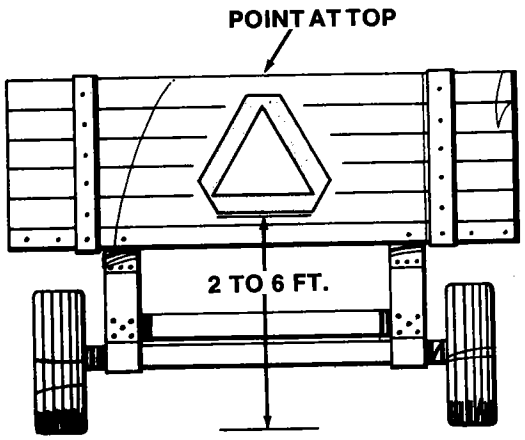


Fig. 9 Proper positioning of SMV emblem on rear of implement.

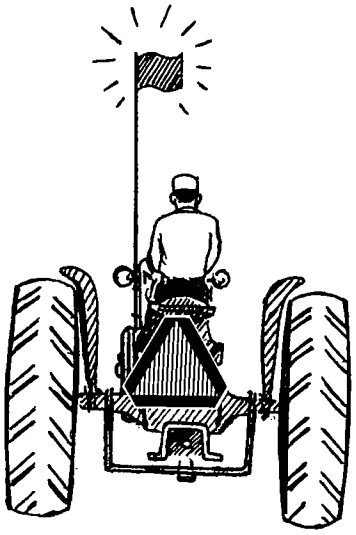


Fig. 10 Identify your tractor as a slow moving vehicle. The triangle is a reflector for day or nighttime use.

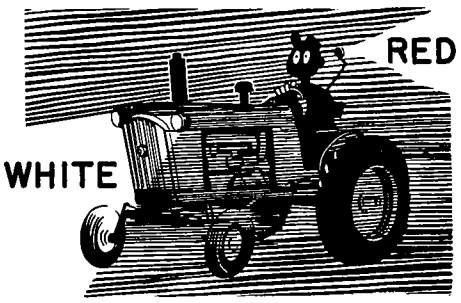


Fig. 11 Use proper lights for night-time driving. Remember to turn off your field lights.

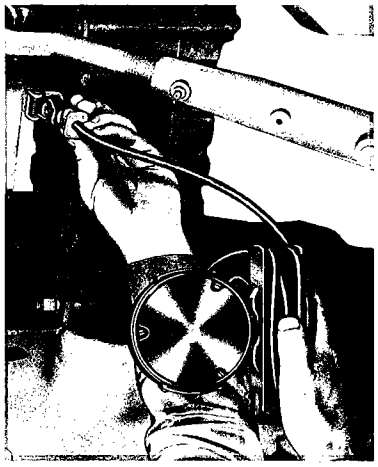


Fig. 12 Extending a light for mounting on a towed implement.

It is dangerous to use a white light to the rear because it might cause a motorist to think the light is the headlight of an oncoming car or motorcycle. It is also dangerous, and sometimes even illegal, to use a flashing red light. In many localities a flashing red light has been reserved for use on emergency vehicles such as ambulances and police cars.

In addition, there should be a light on the farthest projection to the left of any part of the equipment to the side of traffic. Whether it be on the tractor or the towed equipment. The clearance light should show red to the rear and amber to the front and visible for 500 feet to the rear. Red tail lights or reflective tape can be applied to the extreme right and left corners of the towed equipment. Lights, electrical connections, and mounting brackets for lighting farm equipment have been standardized so they can be used on all combinations of tractors and equipment.

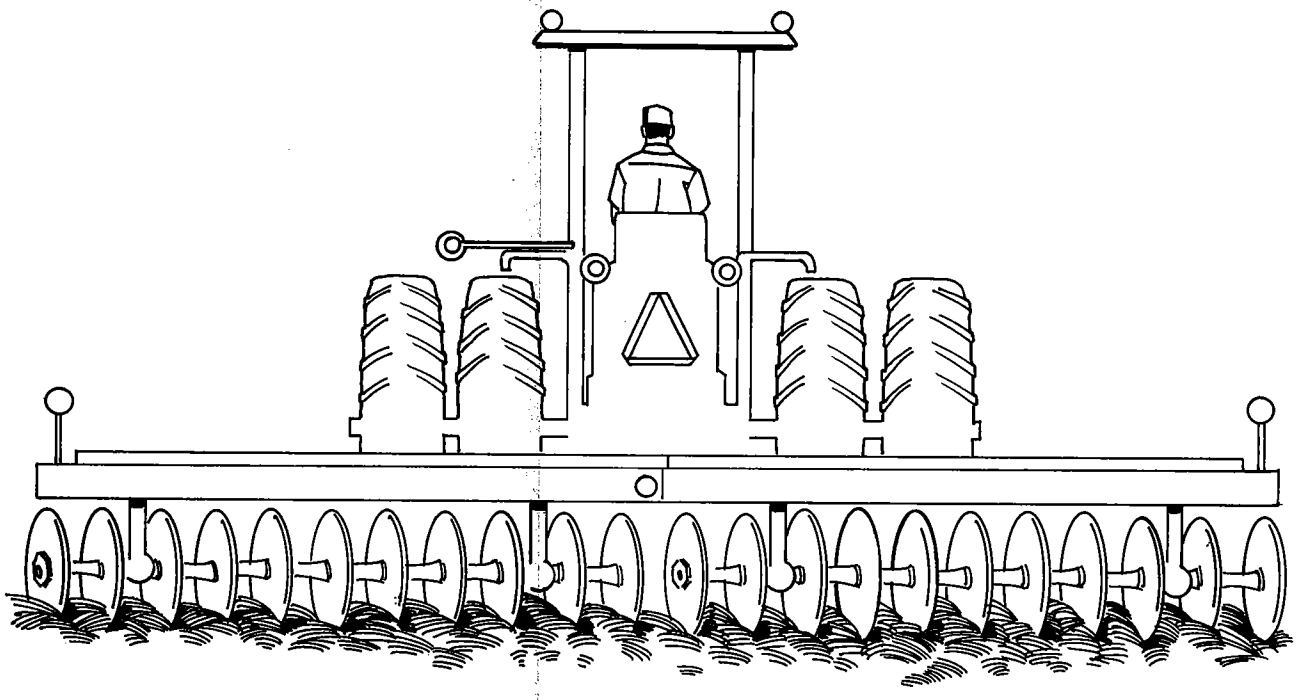


Fig. 13 Recommended lighting and marking for towed farm equipment.

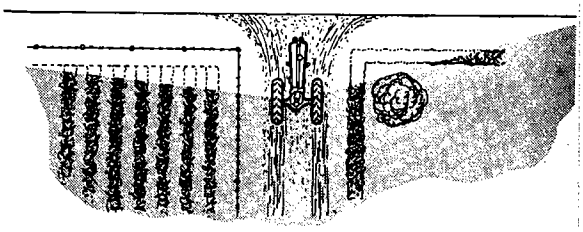


Fig. 14 Keep driveways clear of shrubbery and growing crops.

BLIND CORNERS

One of the major hazards in rural areas is blind intersections and driveway entrances that have growing crops or shrubbery that restrict vision toward the other lanes of traffic. Check with your leader. Perhaps your club could make a project of clearing some of the blind corners in your community. Be sure you first obtain permission from the landowners and tenants. Clear your driveway so that visibility is extended for at least 700 feet in both directions.

TRACTOR SAFETY ON THE HIGHWAY

SAFE EQUIPMENT

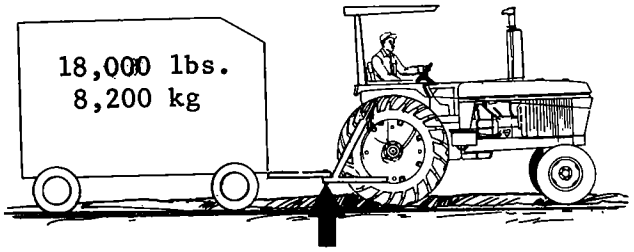
In the First and Second Year projects you learned about the importance of keeping your equipment in safe operating condition. It is even more important to have your equipment in safe condition when it is taken onto the highway.

When you travel on highways or public roads you are traveling at speeds much faster than you would use for field work. This means that the mechanical condition of your tractor must be perfect. A routine daily safety inspection is the best way to find and eliminate hazards before they can cause trouble. Be particularly alert for loose or missing bolts and nuts in the wheels, and check for cracks in the wheel castings. Take a good look at the tires to make sure they are suitable for use on the highway. Check the tire pressure.

Inspect the steering mechanism for loose play. You may not have noticed it in the field, but it doesn't take much looseness to cause trouble on the highway.

In normal field use, brakes do not always wear evenly. This is because the tractor is usually turned more in one direction than the other. If the brakes are not adjusted evenly, applying both brakes in a sudden stop could cause the tractor to upset. Adjustment of the brakes is discussed in this book in Unit 4 "Steering, Brakes, and Front Wheels." The brake petals should be locked together for highway travel. Tractors can pull far more weight than they can safely stop in an emergency. Over estimating the braking ability of a tractors brakes is a common error made by many operators.

For safe braking a tractor should never pull a load that is heavier than the tractor. A tractor weighing 18,000 lbs (8200 Kg) will safely pull and stop a load weighing 18,000 lbs (8200 Kg).



To maintain safe steering it is also important not to over load the drawbar on a tractor. Excessive weight on the drawbar will cause the front of the tractor to become lighter due to the rearward shift in weight. A tractor is designed to carry approximately 30% of its weight on the front wheels or 3000 lbs (1350 Kg) for a 10000 lb (4500 Kg) tractor. When loading a 2 wheel type trailer try to center the load just ahead of the trailer axle so the trailer carries the weight instead of the tractor drawbar. Weights can also be added to the front of the tractor to counter balance the effects of a heavily loaded drawbar.

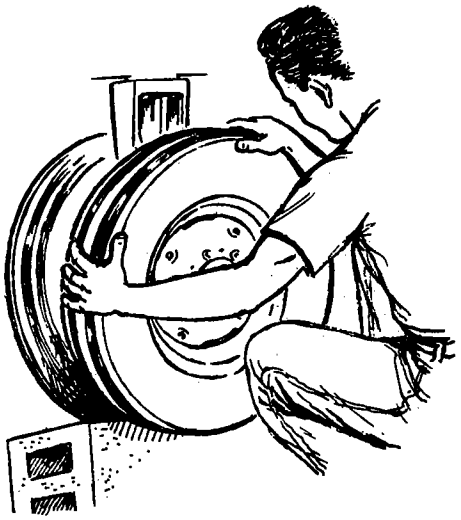


Fig. 15 Checking for loose steering. Is your tractor safe?

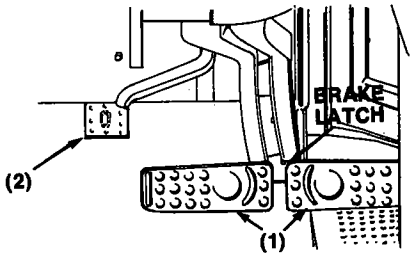


Fig. 16 Brake pedals (1) should be latched together for highway travel. CAUTION: If your tractor has a differential lock (2), it should not be engaged for highway driving, at high speeds or turning. Loss of control can result.

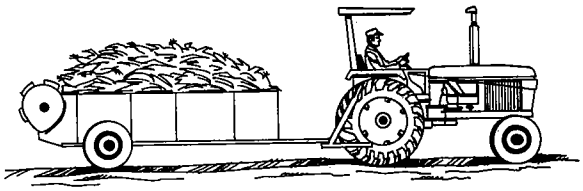


Fig. 17 Never pull a load that's heavier than the tractor.

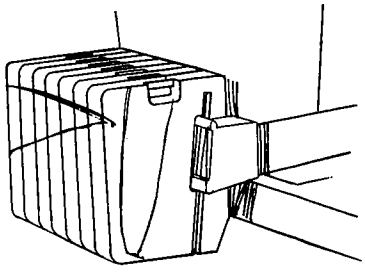


Fig. 18 Front end weights

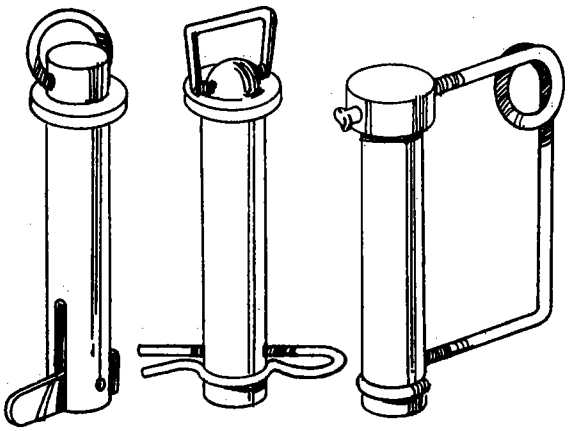


Fig. 19 Always Use A Safety Hitch Pin

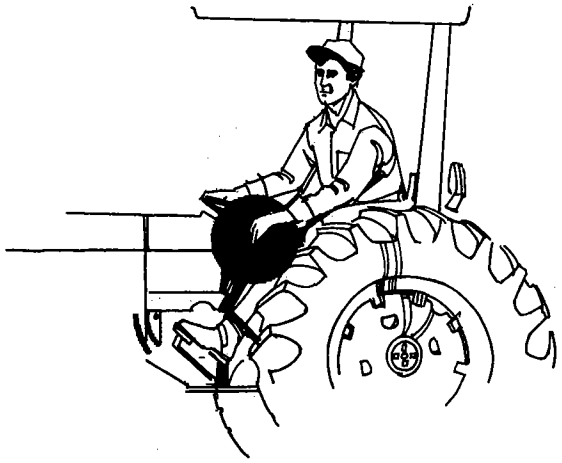


Fig. 20—Shift To A Lower Gear Before Going Downhill

If you are pulling a heavy load behind your tractor, drive slower and allow plenty of distance for stopping when approaching an intersection or stop sign. As a safety precaution, start slowing down far enough ahead so that a complete stop can be made without the brakes.

Use great care when stopping a tractor with a load behind. It takes only a little braking pressure on the load to cause the hitch to jackknife and upset your tractor.

Safety hitch pins should always be used when pulling a load with the tractor drawbar. The locking feature of the safety hitch pin will prevent the pin from bouncing out and unhooking the trailer or implement from the tractor.

Your tractor tires may contain a liquid or other heavy ballast. If this is the case, be sure both tires are filled to the same level. If the load in the rear tires becomes unbalanced while the tractor is traveling at a high rate of speed, the tractor can go out of control. You may have to reduce speed in order to maintain control of your tractor.

Be careful when going down a hill or grade. Shift to a low gear before starting down a hill and leave the tractor in gear. CAUTION-Some of the transmissions in modern tractors will not hold a load in certain gears when going down a grade. Check your Operator's Manual to see which gears can be used safely when going down a hill.

Rear view mirrors are especially helpful to persons who operate tractors on highways. The mirrors allow the driver to watch traffic approaching from the rear without having to look back over his shoulder. Remember a slight turn of the steering wheel can easily occur if the driver isn't watching the road carefully.

Rollover protective structures (ROPS) such as roll bars or cabs have saved many lives during the last few years of their use.

The ROPS protects the operator by (1) limiting the upset to 90 degrees and by providing a frame of safety so the operator is not crushed in the overturn.

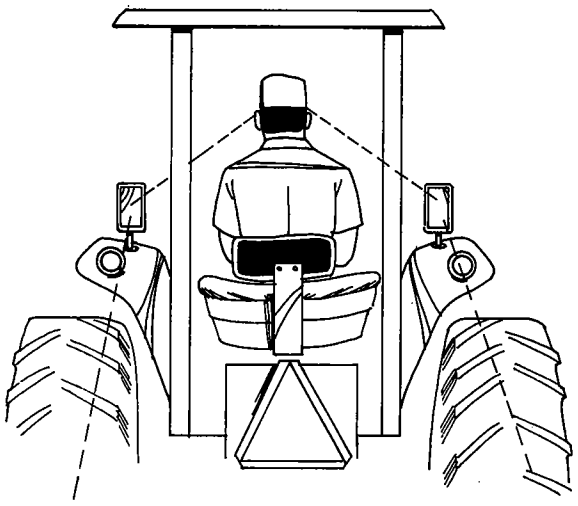


Fig. 21 Rear view mirrors, correctly positioned and securely mounted, are useful on the highway or in the field.

TRACTOR SAFETY ON THE HIGHWAY

Protective frames are generally two or four post structures which are attached to the tractor frame.

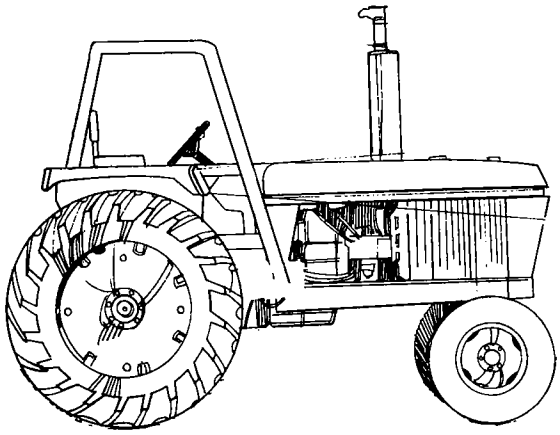


Fig. 22 Four-post frame with a weather canopy.

Tractors with rollover protection are also equipped with seat belts. It is important to wear these belts to insure operator protection in case of a roll over. Many rollovers have occurred where the operator was not injured because his tractor was equipped with rollover protection and he was wearing his seat belt.

The rollover protective cabs now give the operator accident protection plus the added advantages reducing noise to safe levels and the comfort of air conditioning.

Reduced noise levels and air conditioning have helped to reduce operator fatigue, another cause of accidents.

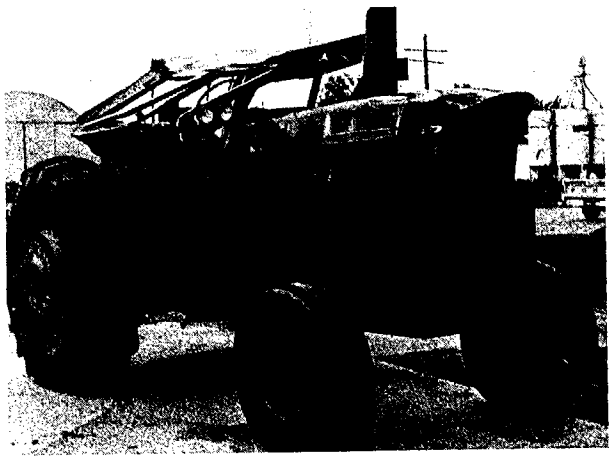


Fig. 26 Early enclosures were designed only for weather protection and may crush in an upset.

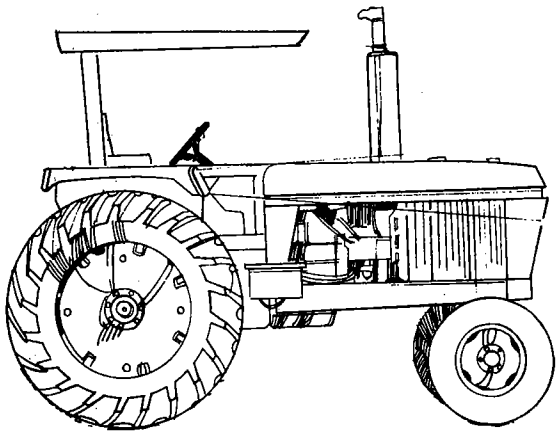


Fig. 23 Two-post protective frame with weather canopy.

Fig. 24 Buckle up if your tractor is equipped with ROPS.

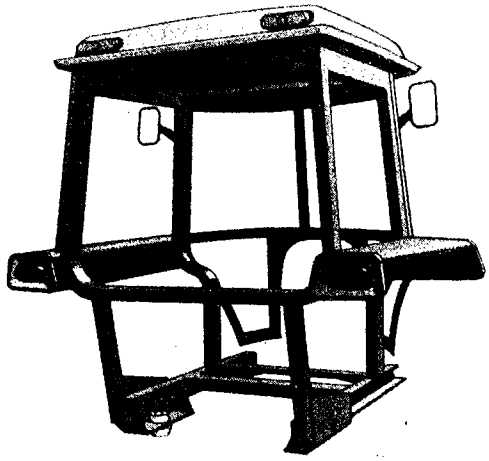


Fig. 25 Heavy metal frame of this enclosure provides rollover protection.

Safety Starts with Courtesy

Let's discuss some accident situations that have actually happened. Read the story of each accident and then discuss it with your leader and the other members. Use the blanks to tell us what you have learned that could help prevent a similar accident from happening to you.

Situation 1 Farmer A was pulling an empty wagon down a single-lane gravel road late at night. He was traveling about 18 miles an hour. When he met an oncoming car he pulled off to the side. The rear wheel dropped into a hole, upsetting the tractor. Farmer A was crushed under the tractor and died instantly.

How could this accident have been prevented? _____

_____

Situation 2 A 16-year-old boy was returning a tractor that had been overhauled in the high school shop. Four other boys went along for the ride. During a little horseplay one of the boys fell from the tractor and caught his pant-leg on the hitch. He was dragged along the ground for about 50 feet before the tractor could be stopped. The boy suffered severe cuts and bruises and spent a week in the hospital.

How could this accident have been prevented? _____

_____

1. Do you operate your tractor or other equipment on a rural road or highway? _____
   How often? _____
   List any dangerous situations you have encountered. _____

2. Do you use slow moving vehicle emblems? Describe how they are used. _____
   _____
   _____

3. Do you use a special lighting on your tractor or equipment for night travel? _____
   Describe how you have lighted your equipment for travel at night. _____
   _____
   _____

4. Make a safety inspection of your tractor. Is it safe for operation on a highway?
   _____

   Tell what you found that could cause an accident on the highway. How about the brakes? Steering? Clutch? Wheels? Tires? _____
   _____
   _____
   _____

   Don't wait! Correct any unsafe items right away!

5. Are there any gears on your tractor that should be used when pulling a load down a hill? _____ Which ones? _____

6. How can you help reduce tractor accidents on highways and rural roads?
   _____
   _____
   _____
   _____

Note: Fill out this work unit, using your own tractor at home. Be ready to discuss your experiences with other 4-H members at your next club meeting.

MEMBERS' CHECK-UP

THIRD YEAR UNIT 1 **TRACTOR SAFETY ON THE HIGHWAY**

Place the letter for the correct answer at the right of the page.

1. It is (A—more) (B—less) dangerous to move farm machinery on the highway than to use it on the farm. _____

2. The electrical socket on tractors for extending a warning light to a trailed implement (A—is) (B—is not) standardized. _____

3. It is safer to (A—pull halfway off the road) (B—get completely off the road) if someone tries to pass you on a two-lane highway. _____

4. The tractor, being a slow-moving vehicle, (A—always) (B—sometimes) (C—never) has the right-of-way over cars. _____

5. The first step to operating a tractor on the highway is to (A—learn the traffic laws which apply to your state) (B—learn to drive a car). _____

6. In a collision between a tractor with out ROPS protection and a car, the driver of the (A—car) (B—tractor) is more likely to become a fatality. _____

7. In a collision between a large tractor with ROPS protection and a car, the driver of the (A—car) (B—tractor) is more likely to become a fatality. _____

8. Lights on tractors should be visible for a distance of (A—200 feet) (B—1,500 feet) (C—500 feet) _____

9. Safe operation of a tractor on a highway begins with (A—courtesy) (B—assuming that others will look out for your safety). _____

10. Records show that most accidents are caused by (A—working when tired) (B—trying to hurry) (C—taking chances) (D—not using what you have learned about being a safe tractor operator). _____

ENGINE IGNITION SYSTEMS
(AND DIESEL INJECTION SYSTEMS)

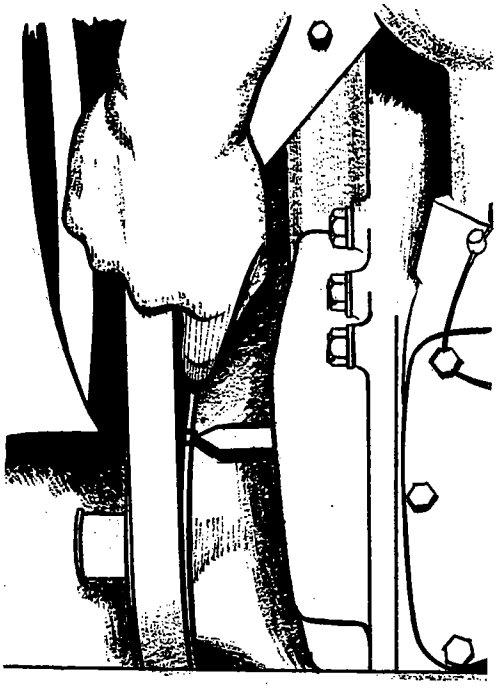


Fig. 2. This is a timing mark on a carburetor engine.

You learned how to service spark plugs and care for the battery in the Second Year Project. These jobs need to be done regularly. Before starting other work on the electrical system, you should service the spark plugs and check the battery.

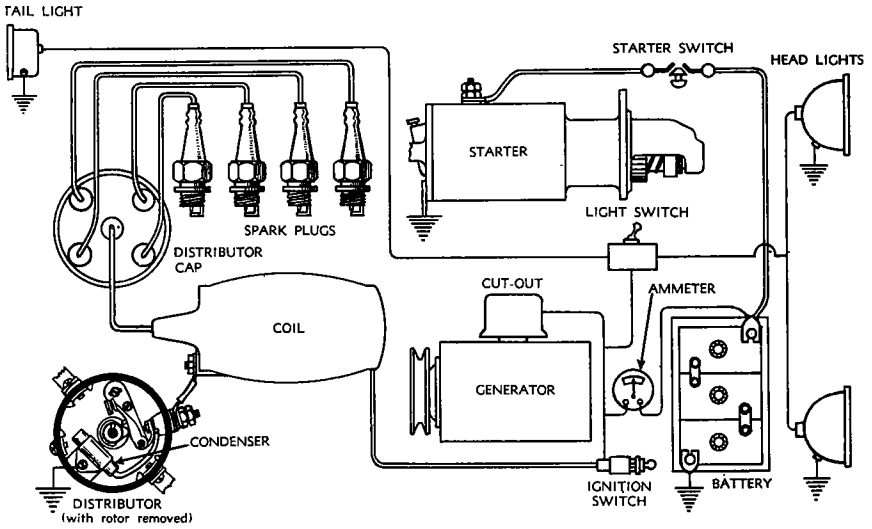


Fig. 1 A tractor electrical system.

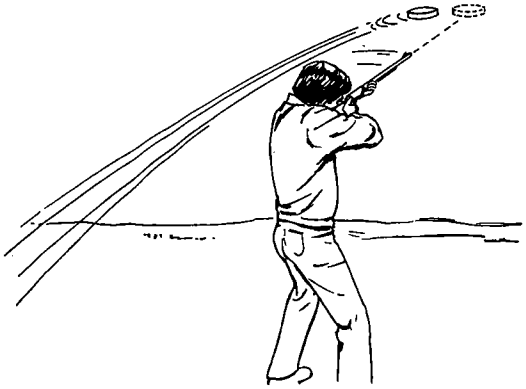


Fig. 3. When you are trap shooting, you "lead" the pigeon so the shot and the target meet at the same point.

IGNITION

In a carburetor engine, a mixture of fuel and air is compressed inside a cylinder. Then a high-voltage spark jumps across the spark plug gap to fire the charge. The spark must be strong enough to jump the gap and it must do so at just the right time. When you are cranking an engine, the piston moves up slowly. It must be near the top of the cylinder before the spark ignites the charge. If the spark occurs too soon the engine will run backward or "kick." To keep the engine from kicking, the spark must be retarded.

In a diesel engine, fuel ignites when it is sprayed into the cylinder which contains hot, highly compressed air; therefore, an electrical ignition system is not needed.

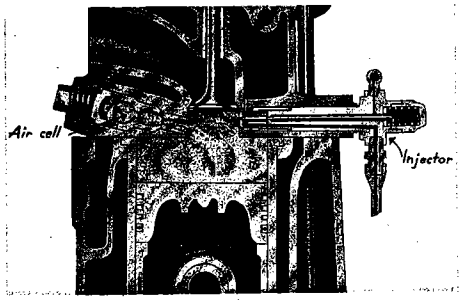


Fig. 4. In a diesel engine, ignition of the fuel is provided by the heat of compression.

It takes about the same amount of time for the fuel to burn and build up pressure when the engine is running slowly or when it is running at full speed. At full speed, however, the piston is traveling rapidly and the spark must occur much sooner so the pressure from the burning fuel charge will come just as the piston starts down. We call this spark advance. The more the air and fuel mixture is compressed the faster it will burn. Therefore, a high-compression engine does not need as much spark advance as a low-compression engine. The ignition system is made so that it will retard the spark for starting, and advance it after the engine picks up speed.

ENGINE IGNITION SYSTEMS

BATTERY IGNITION SYSTEMS

Older tractors used a magneto ignition system that did not require a battery. The magneto is a little generator that makes its own electric current. After generating the current it uses a coil, breaker points, condenser, and distributor to provide a hot spark at the right time.

In a battery ignition system, electric current is supplied by a battery (charged by a generator). Otherwise, battery ignition systems have about the same kind of parts as the magneto system. They have a coil for changing low-voltage current to high-voltage, and a distributor for directing the sparking current to the proper spark plug.

The battery ignition system also has breaker points and the spark is generated as the points open. A condenser keeps the points from sparking. In a battery system, you can tell by looking at the breaker points whether a condenser is of the proper size. If the points are greatly pitted, the condenser may need to be replaced.

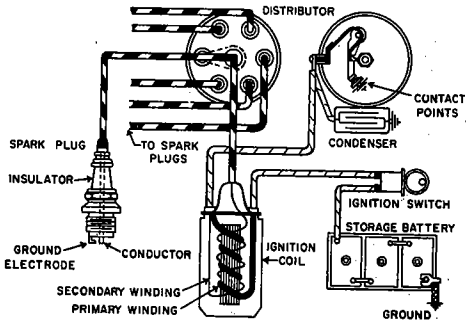


Fig. 5. Battery ignition system for carburetor engines.

HOW THE COIL WORKS

To increase the voltage of the battery electrical system, a coil is used. In the center of the coil is a soft iron core. Over the core are wrapped a few turns of heavy wire, called the primary. As current flows through the primary winding, it is interrupted by a set of breaker points. A condenser made of two strips of metal separated by a thin piece of paper and wound in a small roll is connected across these points. As the breaker points interrupt the current, it surges quickly into the condenser and then out again. The condenser keeps the points from arcing and burning. The condenser is also used to make a current of higher voltage flow in the secondary winding.

The secondary winding consists of many thousand turns of fine wire. As the current is induced into these many turns of fine wire, its voltage is increased to more than 20,000 volts. Because of the high voltage the current will now jump the gap at the spark plug.

You might compare voltage to the pressure needed to shoot a stream of water across a yard—the farther you wish to shoot the water the more pressure you need. In an electrical system we call this pressure high voltage. It is this high voltage that can give you a shock if you're not careful.

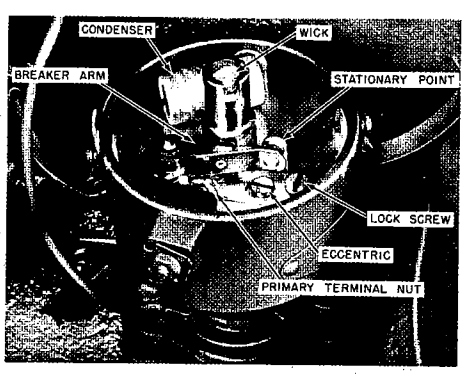


Fig. 6 Distributor with cap removed.

DISTRIBUTOR

After producing a high-voltage current just as the breaker points open, the next thing the ignition system must do is carry the current to each spark plug in turn at the proper time. A distributor is used to do this. The distributor is a rotating switch driven by the engine through gears. It usually rotates at one-half engine speed. Each time the sparking current is produced, the switch connects to a different terminal. By running heavy ignition wires from the proper terminal to the proper spark plug, each plug fires at the right time. The heavy insulation is needed so that the spark will not jump from the wire.

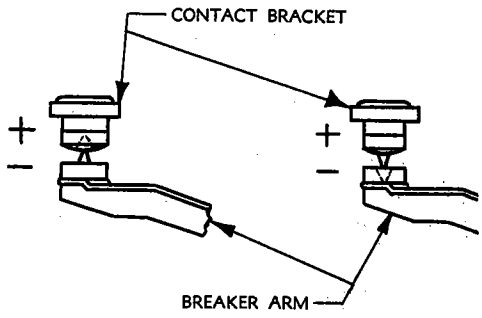


Fig. 7 Badly pitted points caused by shorted or over-capacity condenser (left) or under-capacity condenser (right).

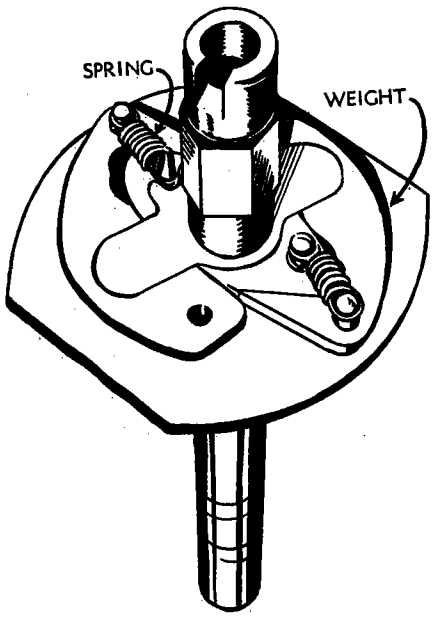


Fig. 8 Automatic spark advance in distributor of battery system.

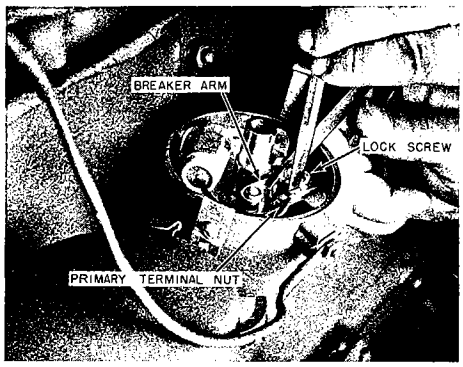


Fig. 9 Adjusting breaker point gap with flat feeler gauge.

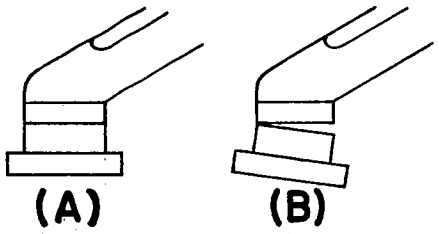


Fig. 10 (A) proper alignment of breaker points. (B) improper alignment causes burning and pitting.

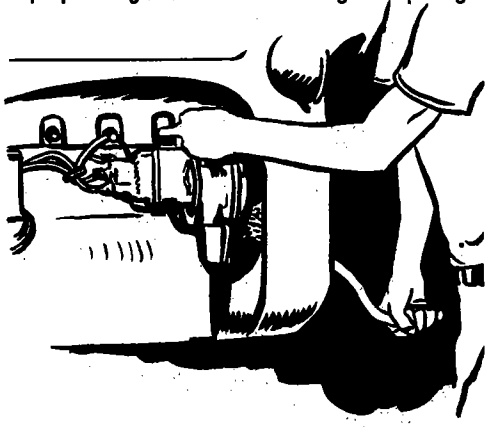


Fig. 11 Checking compression at No. 1 piston.

AUTOMATIC SPARK ADVANCE

The spark advance for the battery ignition system is more flexible than that for a magneto. With a magneto, you retard the spark for starting and after the engine reaches a speed of about 450 rpm or more, you have full spark advance. In a battery system the spark is retarded by springs pulling against weights. When starting, the springs keep the weights pulled in and the spark is retarded. As the engine picks up speed the weights pull out and gradually advance the spark. Any change in engine speed also causes a change in the spark advance. The result is better idling and somewhat better load-pulling ability at low speed.

CHECKING BREAKER POINTS

The breaker point gap should be checked periodically. Your Operator's Manual will tell you how often to make this check. It will also give the proper spacing.

Always use a flat feeler gauge to check the spacing. Be sure the engine has been turned until the points are wide open. The proper gap is provided when there is a slight drag on the feeler gauge as you pull it between the contact points.

If the points are set too close they will burn and pit rapidly. If the points are set too wide they may cause a weak spark at the higher engine speeds. Be sure the breaker points fit together squarely. If they make only partial contact, there will be burning, pitting, and uneven wear. You may have to bend the points into position to get them to fit squarely. Be careful! Ask Dad to help if you are not sure.

When you finish working with the breaker points, run a strip of clean paper between the contact surfaces to remove any grease or dirt particles. Grease or dirt on the points will cause burning and pitting.

The breaker point gap should be adjusted before the engine timing is adjusted.

TIMING

Showing how to time an engine makes a good demonstration. Your Operator's Manual tells you how to do this job.

There are two steps in timing an engine. First, rotate the crankshaft until the engine is completing the compression stroke for the No. 1 cylinder. The No. 1 cylinder is the one nearest the front of the engine. On four and six-cylinder engines, this takes place when the back exhaust valve (the one nearest to the flywheel) closes. Just as this valve closes, the No. 4 cylinder has completed its exhaust stroke and the No. 1 cylinder has completed its compression stroke. Another way to check the compression stroke is to remove the No. 1 spark plug. Place your thumb over the hole and turn the engine until you feel pressure. Then turn slowly until the timing marks are lined up.

After the engine is in proper position for firing cylinder No. 1, the second step is to set the ignition system so that it has just produced a spark. Then connect the ignition system to the engine.

ENGINE IGNITION SYSTEMS

TIMING A BATTERY IGNITION SYSTEM

Turn the engine over to the point where you want a spark. Then rotate the distributor case carrying the points until a spark is produced. A spark is always produced just as the breaker points separate.

Some engines are timed with the spark advanced. A timing light is usually used where you want to time with advanced spark. Ask your dealer or leader to show you how to use a timing light. To time the engine, hook the light to the No. 1 or No. 4 spark plug wire, or on a six-cylinder engine to the No. 1 or No. 6 wire. Run the engine and note if the light goes on just as the timing mark on the flywheel or fan pulley is lined up with the pointer.

If you do not have a timing light, you can time the engine by turning it until the spark advance mark is lined up with the pointer. Then advance the distributor rotor by turning it in the direction of rotation and holding it in the advanced position. This advances the cam, which opens the points. Turn on the switch and rotate the distributor case in the opposite direction until a spark occurs. Better have your leader or dad show you how to do this.

You can tell the direction of rotation of the rotor on most tractors by turning it with your fingers. With the engine stopped, you can turn the rotor a short distance in the direction of rotation. The reason you can turn it is because you are throwing the spark advance weights out against the spring.

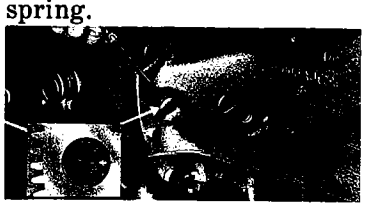


Fig. 15 Removing flywheel timing hole plug.

TIMING A DIESEL ENGINE

A diesel engine does not need a special ignition system. It depends on the heat of the highly compressed air to start the fuel burning. The fuel pump must be timed so as to inject fuel at the proper time. Timing a fuel pump varies on different engines. Therefore, if you have a diesel it will be necessary for you to refer to your Operator's Manual to determine how it should be timed. Better have an older, experienced person help you with this job.

It is important when working with a diesel engine to *KEEP ALL PARTS CLEAN.* Before disassembling any fuel lines, be sure to clean off the dirt. It is also a good idea to use a piece of tape or a cap to close off the line while it is disconnected. If you take out an injector nozzle, handle it carefully. The spray from an injector nozzle can puncture your skin, so *NEVER* point an injector at anyone.

To check the timing on a diesel engine, turn it until it is on the compression stroke for the No. 1 cylinder. Then check the timing marks on the pump to see if they are in the proper position.

Timing the injection pump and cleaning the injection nozzles are jobs that require skill. When you first attempt these jobs, make sure you have someone help you who has done this work before. On some diesels these jobs may require special tools. If the jobs are not listed in your Operator's Manual, have this work done at your tractor dealer's shop.

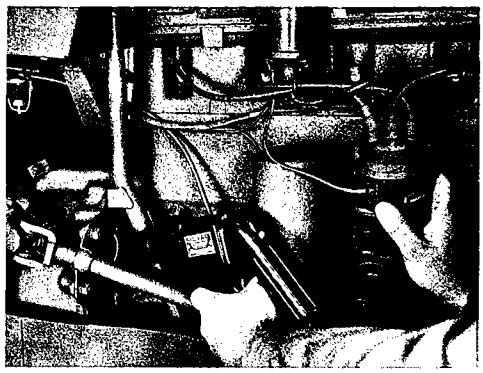


Fig. 12 Using a timing light.

Fig. 13 Checking direction in which rotor turns.

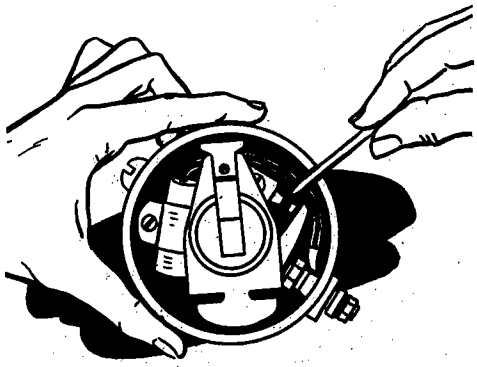


Fig. 14 Rotating the distributor case to time a battery ignition engine.

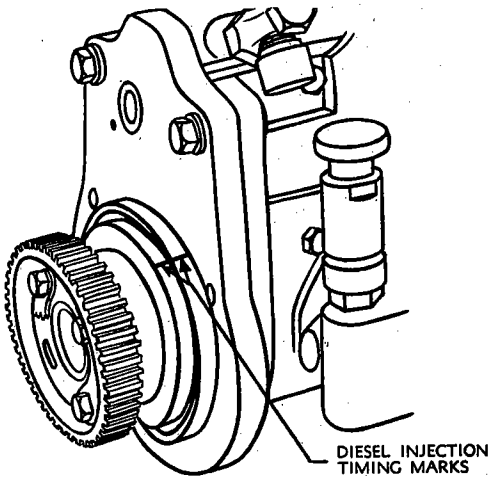


Fig. 16 Timing marks on the fuel pump of a diesel.