Introduction

A high percentage of the small engines in use today in the United States are probably applied to some piece of lawn or garden equipment and are being operated by over 27 million families. Lawn equipment is the most popular, although garden equipment is also common. Rotary tillers and garden tractors are used by thousands of families. Some small electric devices such as grass shears and hedge trimmers also need attention if they are to be cared for properly and used safely. Major emphasis in this manual will be placed on the lawn mower, rotary tiller and garden tractor.

Rotary Tiller

The rotary tiller is a machine designed for seed bed preparation, cultivating, furrowing, composting and mulching. It is engineered to perform many useful labor-saving tasks in the garden. Two common sizes are three and five horsepower.

Rotary Lawn Mower

The rotary lawn mower is the most common type in use today for home lawns. Walking mowers are either push-type or self-propelled, usually having a cutting blade of 18 to 21 inches in diameter and powered by a three and one-half horsepower engine.
Riding rotary mowers are desirable for large lawns, having cutting widths from 25 to 32 inches, and are powered by 5 to 10 horsepower engines. A small walking rotary mower is usually needed for trimming work.

Riding Rotary Mower

The reel-type mower, either push or self-propelled, is designed for use on smooth lawns. Its cut varies from 16 to 25 inches. It is powered by a two to five horsepower engine, depending upon design and width of cut. Prices of reel mowers are usually higher than rotary mowers.

A garden tractor is a versatile machine. Mounted with a variety of tools, such tractor can be used around the home grounds to plow gardens, mow lawns, spray plants, cultivate, dig holes and remove snow.

More than a quarter million tractors with engine ratings between eight and 16 horsepower are manufactured in the United States each year.
SAFETY INSTRUCTIONS FOR LAWN MOWERS

Preparation For Safe Mowing

(1) Read the owner's manual and be sure you know how to stop the engine quickly. All controls are important so be familiar with their operation. Before you operate alone, have a check-out by a qualified operator.

(2) Inspect the lawn before each mowing to be sure any stones, sticks, bones, toys or any other debris have been removed. This is especially important if children frequently play on the grass. The alert operator will keep his eyes open for any unremoved items and will stop and pick them up during the mowing operation. Keep a clean lawn.

(3) Inspect your mower before using it. Tighten any loose nuts, bolts and screws and be sure the blade of the rotary mower is tight. Keep all shields and safety devices in place. Before inspecting the mower, be sure to disconnect the spark plug wire.

(4) Wear long pants or slacks and good sound shoes while using the mower. Do not operate the mower while wearing sandals, shorts or in bare feet.

(5) Keep everyone a safe distance away from the area of operation — especially children and pets.

(6) Service the engine before starting it. Check the oil and fill to the required level if oil is needed. If you have a full day of operation, be sure to check the oil at least twice, once before starting and again at midday.

(7) Handle gasoline with extreme caution. Fill the tank before starting and avoid spilling any gasoline. Gasoline should be stored in approved containers such as a safety can, never in a glass jug or an unapproved plastic container. Fill the fuel tank outdoors and remember gasoline readily vaporizes and it is the vapors that are dangerous. It can be dangerous to fill the tank when the engine is hot so take a break when it is time to refuel.

(8) Adjust the height of cut, if necessary, to fit the conditions under which you will be mowing. It may be necessary to mow the same area twice if grass is tall. Be sure the engine is stopped when making height-of-cut adjustments.
(9) Disengage clutches and shift into neutral before starting engine. Make these safety checks each time before operating any power mower.

(10) Do not operate the mower if someone comes into the area unexpectedly. Be sure to caution anyone who is working with you. If you have to stop to visit with someone, shut off the engine of the mower.
Many of the safety instructions which apply to lawn mowing are applicable to all types of mowers. Beginners should periodically review the safety rules and then follow them prior to mowing and during the mowing operation. There are other instructions in addition to the safety rules.

Before mowing be sure the engine is properly serviced and checked out. Use of a daily maintenance check sheet is a good practice.

To keep a good lawn, proper mowing is necessary. Cutting close weakens the grass, and causes shallow, weak roots and weed infested turf. One and one half to two inches is the ideal height for most varieties of bluegrass. Common Kentucky bluegrass and the older lawn varieties, normally do best when cut at two inches. Some of the new varieties perform well at lower cutting heights. It is frequency, not height of cut, which usually determines the attractiveness of a lawn.

Adjusting Height of Cut

The method of changing height-of-cut varies with the design of the mower. Follow the manufacturer’s directions if you are not sure how to make the adjustment.

(1) Move traction control into disengage position and shut engine off before adjusting height-of-cut.

(2) Place thumb against inside of pivot arm knob and fingers against outside of wheel.

(3) Pull pivot arm out until its locating stud disengages notch in side of mower housing; then move pivot arm to desired setting and release locating stud into notch in mower housing.

(4) Adjust all wheels to same height-of-cut.

Starting and Stopping Instructions

A high percentage of lawn mowers have manual start systems which require hand cranking. In any case, be sure to follow the manufacturer’s instructions for start-up. Start-up procedures for small engines is covered in the 4-H Small Engines Program Manual. If start-up difficulties are encountered refer to the “Trouble Shooting Section” in that manual.

(1) If the lawn mower is a self-propelled model be sure to put the traction drive control in the disengage position. On riding lawn mowers you should also disengage the blade if this is possible.
(2) Be sure spark wire is securely on the plug and ignition key in the on position. On most models the on-off switch is part of the throttle control.

(3) Move the throttle control to the "start" position. This accomplishes a number of things — the throttle is opened, the choke is closed and the grounding switch is opened and should permit the spark plug to fire when the engine is cranked. If there is a separate manual control for the choke be sure to close it. A cold engine requires a closed choke at starting time.

(4) If necessary, move the mower to level ground and in an area where the grass is short. A mower is hard to start in high grass. Put one foot firmly on the mower housing and keep the other foot from beneath the housing.

(5) After the engine starts, move the throttle control to the desired speed setting.

(6) To stop engine, move the traction drive control (self-propelled models) to the disengage position. When the throttle control is at the off position, the spark plug should be grounded and no spark will occur between its electrodes.

(7) Pull the spark wire off the plug to prevent the possibility of accidental starting when the mower is unattended or not used.

Mowing Instruction

Mowing practices vary. They depend upon the shape, objects to mow around and rough, uncertain areas in the lawn. Some general rules can be applied to almost any lawn.

(1) Be sure all guards provided by the manufacturer are in place. For example, the rear safety shield is an excellent addition on recent models.

(2) Always cut the grass when it is dry.

(3) Always walk behind the mower and be sure, with self-propelled units, that you are in control.

(4) Cut long grass with height-of-cut at highest setting. Then cut grass again using a lower setting.
(5) A mowing pattern is important in that it is best to discharge the mowed grass on the mowed portion of the lawn. This practice makes it easier on the engine and a more efficient operation and maybe faster. The mowing pattern is not as critical when a bagging attachment is used to collect the clippings.

(6) Changing the direction of mowing every other time a lawn is mowed is recommended. This may be contradictory to rule five, but is better for the lawn. It may require some raking.

(7) If the discharge chute on the mower becomes plugged with grass, the engine should be shut off before cleaning. Also disconnect the spark plug wire before starting the cleaning operation.

(8) If a solid object is hit by the blade or if mower vibrates abnormally, shut engine off immediately and wait for all moving parts to stop. Remove key from switch if mower has key start. Disconnect high tension wire from spark plug and keep wire away from plug to prevent possibility of accidental starting. Check mower for possible damage, bent blade, an obstruction, or lost part(s). Make all repairs before using the mower.

(9) If a gravel driveway, road, or side walk must be crossed, shut engine off so loose sand and rocks are not thrown.

(10) When using a walking rotary mower, cut across a slope, not up and down. To keep the carburetor on the up-hill side of the engine, you may need to mow in only one direction. Use caution when mowing on uneven terrain and maintain good footing.

(11) Cut grass during the daytime or when there is adequate artificial light. Do not cut wet grass; it is best to cut grass when it is dry.

(12) After the mower is used, the underside of the housing should be cleaned. If the unit has a wash-out port it is easy to do by connecting a garden hose and apply moderate water pressure. Start the engine and allow it and the water to run for about two minutes.
(13) Some lawn clean-up may be necessary after the mowing operation. A lawn will look more attractive if the clippings are removed. This is especially true if the lawn is not mowed frequently enough.

**Extra Rules For Riding Mowers**

(1) Become familiar with all controls and know how to use them. You may need to know how to stop the engine quickly. Never allow children to operate the riding mower.

(2) Never carry a passenger.

(3) Start the engine when parking brake is set, the blade is de-energized and the transmission is in neutral. If possible move the height of cut control to the highest cutting level.

(4) When using the riding mower, stay alert for holes in the terrain and other hidden hazards. To prevent tipping or loss of control, do not drive close to a ditch or creek.

(5) Cut steep grass slopes up and down; never across the face. When going uphill or downhill do not stop or start suddenly.

To prevent tipping or loss of control, reduce speed on slopes and when making sharp turns. Extreme caution must be used when changing direction on slopes. If a steep hill must be cut, back the rider up the hill and drive forward down the hill.

(6) Watch out for traffic when crossing roads or near roads and always yield the right-of-way.

(7) When driving from one area to another, crossing a gravel driveway, road or sidewalk, move blade control into DISENGAGE and raise mower housing to its highest level. This will prevent loose sand, rocks and other debris from being thrown by the whirling blade.

(8) Always use the drawbar hitch point at the rear of the chassis for hauling a small trailer. Limit loads to those that can be controlled safely. Be careful when backing and turning.

(9) Before leaving the operator's position or leaving the mower unattended, shift transmission into neutral, set parking brake, move blade control into DISENGAGE, turn ignition key to OFF, and remove key from switch.
Activities And Demonstrations

(1) Demonstrate how to prepare a lawn mower for safe use.

(2) Prepare a list of safety rules which you can follow when mowing your lawn.

(3) Prepare a list of safety rules which apply to the riding lawn mower.

(4) Demonstrate how to start an engine.

(5) Demonstrate how and why you change the height of cut with a lawn mower.

(6) Explain why different mowing patterns are important.

SAFETY INSTRUCTION FOR THE ROTARY TILLER

Safety instructions for the tiller are important and should be followed. They are important to the operator, the tiller mechanism and the engine. Failure to follow the instructions may result in personal injury or breakdown of the piece of equipment.

(2) Keep everyone, especially children and pets, away from the area of operation. Remove glass, metal objects, sticks, stones, wire and any other debris that might get caught in or possibly be thrown by the tines.

(3) Keep all shields and safety devices in place. If shield, safety device, or decal is defective or damaged, repair or replace it before using the equipment. Also tighten any loose nuts, bolts and screws.

(4) Wear long pants and substantial shoes while using the tiller. Do not operate tiller while barefoot, wearing sandals, tennis shoes, sneakers or shorts.

(5) Fill fuel tank with gasoline before starting the engine. Avoid spilling any gasoline. Since gasoline is highly flammable, handle it carefully.

Before Operating

(1) Read and understand the contents of your owner's manual before starting and operating the tiller. Become familiar with all controls and know how to stop tiller quickly. NEVER ALLOW CHILDREN TO OPERATE TILLER.
(a) Use an approved gasoline container.

(b) To prevent a possible accident, fill the tiller's fuel tank outdoors with the engine off and cool.

(c) Wipe up any gasoline that may have spilled, and install gasoline container cap and tiller fuel tank cap before starting the engine.

(6) Check the oil level in the engine before starting. Be sure the tiller is located on a level surface to permit an accurate oil level reading.

While Operating

(1) Do not run the engine indoors. Exhaust fumes can be deadly. If necessary, however, open the garage doors and be sure there is a cross draft.

(2) Tilling the soil demands attention. Always maintain secure footing, balance and control.

(3) Till the soil when it is dry. Wet or sticky soil can cause mechanical damage.

(4) Keep face, hands, feet and any other part of the body or clothing away from concealed, moving or rotating parts such as the tines, belt and pulleys. Stay behind the handles and away from the tines while operating the tiller.

(5) Release clutch control, shut engine off and wait for all parts to stop before removing any obstructions from the tines. Use a stick to remove the obstruction.

(6) If a solid object is hit by the tines or tines get plugged, release clutch control and shut engine off. Remove high tension wire from spark plug; then check for possible damage, an obstruction or loose parts. Use a stick to remove any obstruction, and make all repairs before using the tiller again.

(7) Before leaving the operator's position — behind handles — release clutch control and shut engine off. Pull high tension wire off spark plug to prevent possibility of accidental starting.

(8) Do not touch the engine while it is running or soon after it is stopped because the engine may be hot enough to cause a burn.

If oil is needed, add enough to bring it up to the point of overflowing.

(7) Wipe up any oil that may have overflowed.
OPERATING INSTRUCTIONS FOR THE ROTARY TILLER

How To Use Your Tiller

The tiller is a precision built machine designed for seed bed preparation, cultivating, furrowing, composting, and mulching. It is engineered to minimize the hardest work in the vegetable or flower garden, to till the soil for planting and cultivating, for composting and stirring chicken litter, and for performing many other useful laborsaving tasks in the garden.

Transport Wheel And Stake Adjustment

The tiller normally has its wheels adjusted so the unit sits level. During digging, as the tines enter the ground and the front of the tiller lowers, the wheels must be raised to level the unit. This is essential for proper engine operation. This adjustment is made by removing the latch pin from the wheel yoke. When the pin is replaced, rotate it until it passes through the slot in the chassis.

The working depth of the tiller is determined by the position of the stake or drag bar. Remove the stake pin to raise or lower the stake or drag bar.

Controlling Speed And Tilling Action

The stake acts as a brake for the tiller and controls the depth and speed at which the machine will operate. By increasing the depth of the stake, the forward speed of the machine is reduced, and the working depth is increased. When the stake is raised, the working depth of the machine is reduced and the forward speed is increased.

The working depth of the machine may be predetermined by setting the stake and wheels so that the wheels are about four inches from the ground when tines and stake are resting on the ground. This setting will permit a working depth of about four inches when the engine is set to run at about ¾ throttle.

When presetting the working depth, the handles should be a little above waist height because the complete tiller will be lower when the tines and stake penetrate the ground. The best handle setting is at waist level while the tiller is being used. The above settings must be adjusted to meet the conditions of the soil to be worked.

The best method of operation will be determined by the soil condition. In some soils, the desired depth is obtained the first time over the garden. In other soils, the desired depth is obtained by going over the garden two or three times. In the latter case the stake should be lowered before each succeeding pass over the garden, and passes should be made across the length and width of the garden alternately. Rocks which are turned up should be removed from the garden area.

The working width of the tiller is normally 26 inches with all four tine sections in place.
Cultivating

For cultivating, a two to three inch depth is desirable. Setting the wheels and stake so that the wheels are about two inches above the ground, while the tiller is resting on the tines and stake, will allow the machine to work at cultivating depth. The throttle should be set from \( \frac{1}{2} \) to \( \frac{3}{4} \) for good cultivation at a slow walking speed.

With standard tines, the working width of the machine is 26 inches. For cultivating this may be reduced to 14 inches by removing the outer tines. In laying out plant rows be sure to allow enough width to permit cultivation between the rows.

For proper decaying action, fertilizer should be applied and worked in with the mulch materials. The breaking up of the leaves and straw and the mixing of it with the top several inches of soil causes the soil to hold moisture longer and allows proper aeration of the plant root system. This also retards the growth of weeds.

Transporting The Tiller

When the tiller is being moved to or from the garden, the stake should be raised up until just the tines and wheels are in contact with the ground. The machine may be moved, under its own power, without damaging grass areas, as long as it is allowed to move freely. If the operator holds back, it will start to dig.

In growing corn or similar crops, checkrow planting will permit cross cultivation and practically eliminate hand hoeing. The tiller has many uses other than tilling and cultivating a garden. One of these is the preparation of lawn area for seeding. The tiller will prepare a deep seed bed which will be free of hard untilled spots, allowing a better stand of grass to grow. The tiller is useful for loosening hard soil for excavation with a shovel. No tedious hand pick work will be necessary.

Your tiller may be used for mixing compost in the pile, or for mixing it with the soil in your garden. This should be done after the soil has been broken to the full working depth. The compost should be worked in to a depth of six to eight inches. This may be done by working the length of the garden, and then by making a separate pass across its width. The addition of decayed organic matter will substantially increase the fertility of your garden.

Activities And Demonstrations

(1) Prepare a list of safety instructions for operating the rotary tiller.

(2) Demonstrate how to adjust the wheels and stake for tilling.

(3) Demonstrate how to prepare the tiller for cultivating.

(4) Prepare your rotary tiller for wintertime storage.
TRANSMITTING POWER

In your grandparents days, most lawn and garden work was done by hand. Garden work required many hours of tedious labor. With the development of the small engine and improved technology, many hours of hard work have been eliminated or decreased.

As early as 1919, a small engine was used to operate a reel type lawn mower. The first garden tiller-cultivator was patented about 1938. The rotary lawn mower was not introduced until after World War II and was powered by a small engine or motor from its introduction.

Today we get power from engines mounted on implements. We may also get power from drive wheels that run on the ground.

Power is transmitted by flat belts, V-belts, chains, gears, clutches, shafts and also by hydraulic pressure. If we need a great deal of turning force (or torque), we don’t change the power — we cut down on the speed of the driven part. We do so by using small gears, sprockets or pulleys. If we want less torque at higher speeds we use larger gears, sprockets or pulleys to drive smaller ones. There is always some friction loss when power is transmitted through gears, belts and so forth.

Different systems are used with different implements, some are very simple where others are more complex and offer greater advantages while requiring increased maintenance and adjustment.

Walking Lawn Mowers

A high percentage of the lawn mowers in use today are of the rotary type. Power is provided in a direct manner since the blade is attached to the engine crankshaft. Blade tip speed should be between 15,000 to 20,000 feet per minute for effective mowing and will require an engine speed of approximately 3000 RPM. This type of mower can be either a push or self-propelled unit. Power to move the push-type mower over the lawn is provided by the operator. Power to move the self-propelled unit is provided by an engine.
Self-Propelled Walking Mowers

Some people prefer to purchase a lawn mower which does not need to be pushed. This makes the mowing job easier, especially if the area to be mowed is large. Power from the engine may be applied to the rear wheels though today it is most commonly applied to the front wheels. This may be accomplished in a number of different ways through the use of gears, belts and pulleys.

Wheels may be powered on a mower from a right angle gear drive on the engine crankshaft or from a pulley mounted on the crankshaft directly above where the cutter blade attaches. Secondly, a V-belt is used to transmit the power to a gear box located over the front axle. Different gears and arrangements in the gear box are used by the manufacturers to provide power to the front axle and wheels. Speed reduction is possible through the gear box and a gear box at the wheels. Engine to front wheel reduction is about 18 to one. Check the transmission of power on your mower to learn how it is accomplished.

The traction drive control of the lawn mower is usually located on a panel mounted on the handle. The control has two positions, engage and disengage, and is connected to the gear box by linkage or to a belt tightener. Traction is positive when the control is in the engage position by meshing gears in the gear box or by tightening the drive belt. More complex clutch mechanisms will be covered under garden tractors.
Riding Lawn Mowers - Compact Tractors

Riding lawn mowers and compact tractors require more complex systems for starting and stopping. They have a more elaborate power train which allows them to function safely and efficiently. The following information should be helpful in understanding the power train on one of the above units or some other small engine.

Clutches

The clutch is the link in the power train between the engine and transmission. The clutch makes it possible for the engine to continue to operate while the operator is shifting gears or stopping the tractor.

On most compact tractors clutch action consists of tightening or loosening the V-belt which transmits power from an engine pulley to a transmission pulley. The clutch is usually actuated by the same foot pedal that actuates the tractor brake.

A typical clutch arrangement is shown in the above right illustration. The engine pulley runs continuously with the engine. To transmit power to the wheels, the operator releases the clutch pedal which presses the tension idler up against the pulley belt and tightens it. To cut off power from the wheels in order to stop or shift gears, the operator depresses the clutch pedal. The tension idler falls away from the belt and loosens it.

Some tractors provide a variable ground speed in each gear by using two belts and a variable speed pulley between the engine and the transmission. The variable speed pulley is usually controlled by a hand lever and the clutch is controlled by a pedal. During de-clutching the center portion of the variable speed pulley moves, loosens one of the belts and stops power transmission.

On some tractors one foot pedal serves for both clutch and brake. Depressing it partly reduces ground speed. Depressing further actuates the variable drive pulley and ends power transmission to the wheels. Depressing it all the way engages the brake that locks the transmission and thus the rear wheels.

The dual-purpose clutch-brake pedal can be hazardous on hilly terrain. The tractor is freewheeling after the drive belt has loosened on the variable drive pulley but before the wheels are braked. Adjustment of linkage is critical.

A few tractors use plate clutches. In a compact tractor the clutch faces may be four or five inches in diameter. When the clutch is engaged the faces are joined and transmit power to the transmission. Depressing the clutch foot pedal separates the clutch plate and disengages the engine from the transmission. A wheel brake linkage is usually part of the clutch pedal assembly. Further depression of the clutch pedal applies the wheel brake similar to the brake action in many belt-type clutch arrangements.
Principle of a Plate Clutch

Transmissions

The transmission reduces the high engine speed of about 3600 RPM to the much slower rear wheel speed. It provides high gear for speed, lower gears for slower travel and heavy loads and reverse gear for backing.

Most compact tractors use a “transaxle”. A transaxle combines the transmission, differential and axle shafts in one case. The transmission may be sliding gear, planetary gear or hydrostatic.

The SLIDING GEAR transmission corresponds to a manual transmission in an automobile. To shift gears it is necessary to depress the clutch pedal, move the gear shift lever to another position and then re-engage the clutch. Most tractors with a sliding gear transmission have three or more forward gears and one reverse.

Regrettably, fewer than half of the compact tractors with sliding gear transmissions have synchromesh. With synchro-mesh, the operator can shift gears while the tractor is moving. Without synchro-mesh, the operator must either “double-clutch” or bring the tractor to a full stop to shift gears.

PLANEYR GEAR transmissions are not commonly used in compact tractors, but they do provide the ability to change gears while moving under load. Both the planetary and the sliding gear transmit power to the drive wheels more efficiently than does the hydrostatic.

The HYDROSTATIC transmission is growing more popular despite the fact that it costs more than a gear transmission and that about one-fifth of the engine horsepower going into the transmission is dissipated as useless heat. But it offers several attractive features: ease of operation, reliable and safe braking action and a nearly infinite variety of ground speeds which can be accurately maintained.
Seat lifted to show hydrostatic transmission. Note cooling fins on transmission case as well as cooling fan.

In most hydrostatic transmissions, the engine drives a variable displacement pump, the pump drives a hydraulic motor and the motor, through a differential, drives the wheels. Usually a compact gear case holds the pump, hydraulic circuits and valves.

The operator sets the direction and rate of flow of oil from the pump to the motor by moving a lever. With the lever in neutral, the swash plate positions the pump pistons so there is no relative movement between pistons and cylinders. No oil flows, so the motor and drive wheels do not move. In forward and reverse, the swash plate positions the pistons to pump oil to the hydraulic motor in one or the other direction.

Some hydrostatic transmissions use a fixed displacement pump and fixed displacement motor. In fixed displacement, oil moves at full flow all the time. At full ground speed, the control valve directs all the oil from the pump to the motor. At slower ground speeds, the control valve diverts some of the oil through the heat exchanger and into the reservoir. In neutral, all the oil is diverted to the reservoir. Oil diverted to the reservoir uses power from the engine but produces no work, so fixed displacement pump motor design is less efficient than variable displacement at part loads.

Circuit of hydrostatic transmission with fixed displacement pump.

To permit towing, most hydrostatic transmissions have a valve that releases a fluid lock and places the tractor in freewheeling. Some hydrostatic transmissions provide means for using the oil pressure to power hydraulic cylinders in attachments like snow blades and front-end loaders.

In cold weather a hydrostatic transmission may be sluggish until the oil warms up.

The DIFFERENTIAL is a gear train between the transmission and the axle that allows the tractor to turn without skidding one of the drive wheels. All tractors, regardless of the type of transmission, have a differential. In most tractors it is combined with the transmission and axle in the transaxle.
Although the differential is necessary, it causes difficulties to certain situations. If, for example, one wheel drops into a hole and encounters resistance, the other wheel with less resistance will spin. By skillful use of individual wheel brakes, the operator of a large farm tractor can drive out of a hole, but very few compact tractors have individual wheel brakes.

However, some compact tractors have limited slip differentials that reduce the problem of individual wheel spinning. They are not necessary for work on surfaces with good traction, but they are worth considering for work in snow removal or on surfaces with uneven traction.

**Rotary Tillers**

Power on most tillers is provided only to the shaft axle to which the tines are attached. Forward or reverse motion of the tine shaft actually moves the tiller. Some units do not have a reverse. Power on some tillers is also provided independently to the wheels which is an advantage with heavier units.

Drive and reverse clutch controls as well as the throttle control are usually located on the handlebars of the tiller.

There are three types of power trains which operate the tine shaft of the tiller. In one type, power from the engine is provided by one or more V-belts from a pulley on the engine crankshaft to a pulley on the worm gear shaft. Two belts and two pulleys are necessary to provide both forward and reverse motion. Idler pulleys are also necessary for the clutch mechanism. This power train might be called a belt, worm gear drive.

Another power train can be referred to as a belt-chain drive. In this drive, power from the engine is provided by a V-belt from a pulley on the crankshaft to a pulley on a jackshaft. From a sprocket on the jackshaft, which runs in the chain case, power is provided to a sprocket on the tine shaft by chain drive.

Belt-worm Gear Drive

An idler pulley on the belt drive serves as the clutch mechanism by tightening the belt or letting it run slack.

Belt Chain Drive
The third type drive train operates off a vertical drive shaft engine and could be referred to as a worm shaft drive with a cone friction connecting it to the crankshaft of the engine. The drive control is found on one of the handlebars and when the clutch is engaged the tine shaft is also energized.

You can make an interesting study of the different drive trains on lawn mowers, garden tractors, rotary tillers or other pieces of equipment. Many different designs are being used to transmit power from the engine by using pulleys, belts, sprockets and chains to get the job done.

**Activities And Demonstrations**

(1) List the small engine applications of lawn and garden equipment at your home.

a) ____________________________

b) ____________________________

c) ____________________________

d) ____________________________

e) ____________________________

(2) Trace the power train on one self-propelled unit.

__________________________________________________________________

__________________________________________________________________

(3) What purpose does a clutch serve?

__________________________________________________________________

(4) What is the purpose of a transmission?

__________________________________________________________________

(5) What are three types of power trains to the tine shaft of a rotary tiller?

a) ____________________________

b) ____________________________

c) ____________________________
Some periodic or annual maintenance, depending on the hours of use, is necessary on all types of lawn and garden equipment. Regular safety checks before using any piece of equipment will point up the need for some immediate maintenance such as loose nuts and bolts. Set up and follow a regular preventative maintenance program on all pieces of equipment.

The maintenance of the engine is covered in the 4-H Small Engine Members Manual and if necessary, refer to it. Regular maintenance procedures will also be covered in your owner's manual. It is important that you check your owner's manual for specific instructions on how to adjust and service your own piece of equipment. Some general instructions are given here to assist you.

Rotary Lawn Mower Maintenance

Lubrication. Be sure to shut the engine off before performing any maintenance service. To prevent the possibility of accidental starting, remove the spark plug wire from the spark plug.

(1) After every 25 hours of operation or at the end of the mowing season, apply two or three drops of light oil on the inside of the wheel bolts. Spin the wheel to distribute oil into the wheel bushings. Wipe up any excess oil.

(2) The throttle cable must be lubricated after every 25 hours of operation or at the end of the mowing season, whichever comes first. Apply light oil onto the cable, especially where it bends. Also, squirt oil into the cable where it enters throttle control housing. Operate the control to distribute the oil. Wipe away excess oil.

(3) Examine cutting ends of the blade carefully, especially where the flat and curved parts of the blade meet. Since sand and abrasive material can wear away the metal that connects the flat and curved parts of the blade, check the blade before using the mower. If any wear is noticed, replace the blade.
(4) Sharpen or replace the cutter blades if necessary. To remove the blade, grasp end of blade using a rag or thickly padded glove. Remove cap screw, lock washer and blade.

**NOTE:** An inexpensive blade balancer can be purchased at a hardware store.

(7) Install sharp, balanced blade with lock washer and cap screw. Sail part of the blade must point toward the mower housing to assure correct installation. Tighten cap screw to 50 ft-lb.

(8) Set mower upright.

**ADJUSTING THROTTLE CONTROL.** Tools required: Screwdriver.

An adjustment of the throttle control may be required if the engine does not start or stop. Whenever a new throttle control cable assembly is installed, the throttle must be adjusted.

(1) Make sure engine is not running and high tension wire is pulled off the spark plug.

(2) Move throttle control lever to the STOP position.

(3) Loosen cable clamp screw until throttle cable is free to slide.

(4) Move carburetor control arm to the left until it contacts grounding bracket. Pull throttle cable slightly to remove any slack and tighten the cable clamp screw to lock the adjustment in place.

**Rotary Tiller Maintenance**

Be sure to shut off the engine before performing any service. Disconnecting the spark plug wire will also prevent any accidental starting.

**LUBRICATING WHEELS AND IDLER PULLEY.** Different types of drive trains on rotary tillers will require more or less service. Some common procedures are as follows:

Tools required: Clean rag and SAE 30 Oil

The wheel bushings and idler pulley must be lubricated after every 15 hours of operation or once a year; however, lubricate more frequently when conditions are extremely dusty or sandy.
(1) Clean area around wheel bushings with rag. Lubricate wheel bushing with a few drops of oil. Spin wheels to distribute the oil, and wipe up any excess oil.

(2) Clean area around pivot point of idler pulley and on back of idler pulley hub. Lubricate pivot point and back of idler pulley hub with a few drops of SAE 30 oil. Spin the pulley and move idler assembly back and forth to distribute the oil. Wipe up any excess oil.

(3) Change gear box oil once a year, preferably at end of seasonal use. If possible, drain oil from gear box after operating the tines for a few minutes because warm oil flows more freely and carries more contaminants than cold oil.

(1) Position tiller on a level surface.

(2) If fuel tank is not empty, pull fuel line off fitting at bottom of fuel tank and drain gasoline into empty gas can. When tank is empty, install fuel line on fuel tank fitting.

(3) Clean area around pipe plug at front of gear box. Next, place oil drain pan below pipe plug.

(4) Remove pipe plug from gear box. Next, grasp handles and tip tiller forward so oil flows into drain pan. After oil drains completely, set tiller back on level surface.

(5) Fill gear box with a good grade of SAE 90 EP gear oil. When oil is at point of overflowing in filler hole, install pipe plug. Wipe up any excess oil.

CHANGING GEAR BOX OIL. Tools required: Clean rag, open end wrench, empty gas can, oil drain pan and small funnel.

ADJUSTING DRIVE CLUTCH BELT. Tools required: ½ inch socket and wrench.
After considerable use, the drive belt will wear and subsequently start to slip on the pulleys. This is evident when the tines do not rotate while tilling. The belt is too tight when the clutch will not disengage from forward drive. A spring compensates for belt wear, but eventually an adjustment is required.

Loosen nut on bottom of cable guide spindle. Pivot spindle outward to increase idler pulley tension on belt. By contrast, decrease idler pulley tension on belt by moving spindle inward. When correct adjustment is achieved, tighten nut at bottom of spindle.

**Adjusting Drive Clutch Belt**

**Garden Tractor And Riding Mower Maintenance**

Larger units such as the garden tractor and riding lawn mower require additional maintenance over that required on small walking units. The many manufacturers use different power trains, steering and braking systems and therefore, specific instructions are found in their owner’s manuals for maintenance procedures. It is important that you know your machine and refer to your owner’s manual for specific instructions on maintenance. Some procedures are common to most machines. In no way is the attempt made to cover all maintenance procedures in this section.

It is necessary to drain the gasoline from the fuel tank before starting some types of maintenance. It is also advisable to drain the oil from the crankcase to prevent leakage if the unit is to be tipped on its side or end.

The following guidelines and illustrations apply to one manufacturer’s piece of equipment. Remember that engine maintenance is covered in the 4-H Small Engine Members Manual. To prevent accidental starting of the engine while performing maintenance, shut off the engine and remove key from the ignition switch. Also, open the hood and pull the high tension wire off the spark plug.

**GREASE FRONT AXLE SPINDLES AND WHEELS.**

Tools required: Clean rag and grease gun with general purpose lithium grease.

The front axle spindles and wheels must be lubricated after every 25 hours of operation; however, lubricate more frequently when conditions are dusty or sandy.

1. Wipe grease fitting on spindles and wheels with a clean rag. If there is paint on front of fittings, scrape it off.

2. Lubricate both axle spindles with general purpose grease. Continue to pump grease until it oozes out the spindle. Wipe up any excess grease.

3. Lubricate both front wheels with general purpose grease. Pump grease gun about four times. Wipe up any excess grease.
**LUBRICATE PIVOT POINTS.** Tools required: Clean rag and oil.

The mechanical pivot points on the rider must be lubricated after every 25 hours of operation; however, lubricate more frequently when conditions are dusty or sandy.

**IMPORTANT:** To lubricate all the mechanical pivot points, the rider must be tipped on its rear end. However, before the rider is tipped, drain all gasoline from fuel tank and oil from crankcase. Failure to do so will result in gas leaking into the crankcase, which could cause engine failure.

1. Shift transmission into first gear and engage the parking brake. Tip rider onto its rear end.
2. Remove mower housing.
3. Move blade control forward into ENGAGE position so brake is away from side of pulley.
4. Remove lock nut from cap screw that holds retainer and idler pulley to idler arm. Lift up the pulley and retainer so belt can be removed.
5. Remove lock nut holding blade pulley on spindle shaft. Slide pulley up and remove belt.
6. To install blade drive belt, loop belt around blade drive pulley and to the inside of the belt guide. Install pulley on spindle shaft with lock nut and tighten nut to 50-60 ft-lb. Install belt between idler pulley and belt retainer/guide, and secure idler assembly to idler bracket with cap screw and lock nut.

**REPLACE BLADE DRIVE BELT.** Tools required: Socket and open end wrenches.

(3) If necessary, remove mower housing from rider chassis.

(4) Lubricate pivot points in the steering, drive, brake and clutch linkage with light oil.

(5) Replace mower housing and with tractor in normal operating position fill the fuel tank and crankcase.
(7) Replace mower housing and with tractor in normal operating position, fill the fuel tank and crankcase.

**REPLACING TRACTION DRIVE BELT.** Tools required: Pliers and socket wrenches.

**IMPORTANT:** To replace the traction drive belt, the rider must be tipped on its rear end. However, before the rider is tipped, drain all gasoline from fuel tank and oil from crankcase. Failure to do so will result in gas leaking into the crankcase, which could cause engine failure.

(1) Shift transmission into first gear and engage the parking brake. Tip rider onto its rear end.

(2) Remove the mower housing if necessary.

(3) Disengage clutch spring from the hole in bottom of chassis. Also loosen the lock nut on idler pulley until belt guide can be removed.

(4) Loosen lock nut holding transmission pulley belt guide in place; then move belt guide to the side.

(5) Remove traction drive belt idler pulley, then rotate belt off transmission pulley and small engine pulley.

(6) To install new traction drive belt, install it around small engine pulley, transmission pulley and idler pulley. Next install idler pulley belt guide and move idler pulley fully toward the engine pulley; then tighten cap screw and lock nut. Tension the belt by hooking clutch spring into hole in chassis. There must be 1/16 of an inch between clevis pin and front of slot in bracket. If an adjustment is needed, loosen jam nut and remove cotter and clevis pin. Rotate clevis until adjustment is correct.

**IMPORTANT:** Make sure belt is an equal distance from both sides of the idler pulley belt guide and transmission pulley belt guide.

(7) Replace mower housing and service engine after placing the unit in its normal operating position.

**CHECKING/ADJUSTING DRIVE CHAIN.** Tools required: Two 2” x 4” blocks, tape measure and socket wrench.

(5) Remove traction drive belt idler pulley, then rotate belt off transmission pulley and small engine pulley.
The drive chain must be adjusted to maintain ¼-⅜ of an inch deflection at mid-span between transmission and differential sprockets. Check chain deflection after every 25 hours of operation.

(1) Check deflection of drive chain by lifting up on chain with moderate pressure at mid-span. There should be ¼-⅜ of an inch deflection. If deflection is not as specified, an adjustment is required.

IMPORTANT: To adjust drive chain, the rider must be tipped on its rear end. However, before the rider is tipped, drain all gasoline from fuel tank and oil from crankcase. Failure to do so will result in gas leaking into the crankcase, which could cause engine failure.

(2) Shift transmission into first gear and engage the parking brake. Tip rider onto its rear end so chassis is on top of 2” x 4” blocks. Wheels must be off the floor so axle can be moved.

(3) Loosen four flange nuts securing pillow blocks with differential axle to the rider frame. Slide differential axle in proper direction to get correct chain deflection; then tighten flange nuts.

(4) Since differential axle must be parallel to rear of chassis, measure distance from center of pillow blocks to rear of chassis. Difference between the two measurements must not exceed ¼ inch, differential axle is not parallel with chassis, therefore it must be readjusted.

(5) Check the deflection of the drive chain from bottom of rider.

(6) Return the unit to normal operating position and service the engine before starting it.

Preparing Tiller And Mower For Storage

(1) Follow the storage instructions for small engines found in the 4-H Small Engine Manual.

(2) When cleaning the external parts of the engine also remove vegetation, dirt and grime from the external parts of the tiller or mower chassis and tines. It is also necessary to clean the underside of the housing on a walking or riding mower.

(3) Check and tighten all cap screws, bolts, screws, nuts and mating parts. If any part is damaged, repair or replace it.

(4) Lubricate wheels and pivot point and be sure any idler pulleys pivot freely.

(5) “Touch up” all rusted or chipped paint surfaces. Make sure to sand affected area before painting.

(6) Store the mower or tiller in a clean, dry garage or storage area. It will help if you cover your equipment to protect it and keep it clean.

Activities And Demonstrations

(1) Demonstrate how to remove, sharpen and balance a rotary mower cutting blade.

(2) Point out and compare the needs for lubrication on a mower and rotary tiller.

(3) Demonstrate how to change and adjust the belt or belts on a rotary tiller.

(4) Demonstrate the greasing of axle spindles and wheels.

(5) Prepare a list of the pivot points needing lubrication on your garden tractor or riding lawn mower.

(6) Demonstrate how to replace a drive belt.

(7) Show how to check and adjust the drive chain.
Although this manual is basically intended to cover lawn mowers, rotary tillers and garden tractors, there are also other pieces of lawn and garden power equipment you may want to learn about.

**Edger/Trimmer**

An edger/trimmer is a versatile machine for giving that fine manicured look to a lawn. It can also be used to provide better and faster water drainage from sidewalks and driveways.

The blade and guard adjust easily for various edging or trimming jobs. The front wheel adjusts up and down, and/or sideways to any of several positions for varying curb heights.

Read the operator’s manual for proper operating instructions and safety rules.

**Shredder/Bagger**

The shredder can be a very useful machine when caring for a large lawn or garden. It is designed to break up and shred dry vegetation instantly for compost.

The machine functions as a bagger for easy disposal of debris and some models take standard disposable plastic liners for direct, quick and easy bagging. An adjustable, multi-purpose “drop chute” permits direct, ground-level rake feeding. Leaves, twigs and debris feed easily into the suction-feed chute.

Follow the manufacturers recommendations for proper operating instructions and for safe operation.

**Power Vacuum**

A power vacuum is an excellent piece of equipment for maintaining a clean lawn, particularly around fences and hedges. This machine can quickly rid lawns, bushes and paved surfaces of debris which
would normally take hours of time-consuming raking and sweeping. The vacuum is equipped with a large “breathing” bag for easy dumping. Easy-to-handle, the power vacuum rolls smoothly on four wheels which are adjustable for varying ground conditions and situations. Power vacuums are usually equipped with either a snout or flexible suction hose.

An owner-operator’s manual will provide proper operating instructions and safety rules and should be used by the operator.

*Leaf Blower*

Powerful airstream pushes leaves and lawn litter to piles for easy bagging or curbside pick-up. The machine may also convert to vacuum or shredding action by adding a blower or vacuum hose attachment. The leaf blower has a full-rotation snout wheel for easier maneuverability.

Proper operating instructions and safety rules are also very important with this machine and should be followed.

*Rotary Hoe*

A power rotary hoe is useful for breaking up ground, cultivating or weeding, aerating lawns and chopping compost. Most of these machines are lighter than rotary tillers, some weighing less than 20 pounds. The hoe is gentle and easy to operate.

Be sure to read the operator’s manual for proper operating instructions and safety rules before using the rotary hoe.
RECORD KEEPING

Some simple record keeping can be interesting as well as helpful to you. Following recommended service practices found in your owner’s manual will prolong the life of your power lawn and garden equipment. For example, how much money it costs to keep the family lawn mown is a question that can be answered only by record keeping.

If you mow lawns or till gardens for pay in the neighborhood where you live, a list of expenses and receipts will be very interesting. Keep your records faithfully and see if you are not repaid by savings in time and repairs. You may want to use a small notebook to record your weekly expenses and receipts and then make monthly entries in the space provided on this page.

If you have kept accurate records and have had some income from your work, you may be interested in your returns per hour.

Receipts minus expenses = Profit

Profit = $

Return per hour of labor is equal to:

\[
\text{Profit} + \text{hours of labor}
\]

Return per hour of labor =

At the end of the season go over your records with your parents and with your 4-H leader.

MONTHLY RECORD

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