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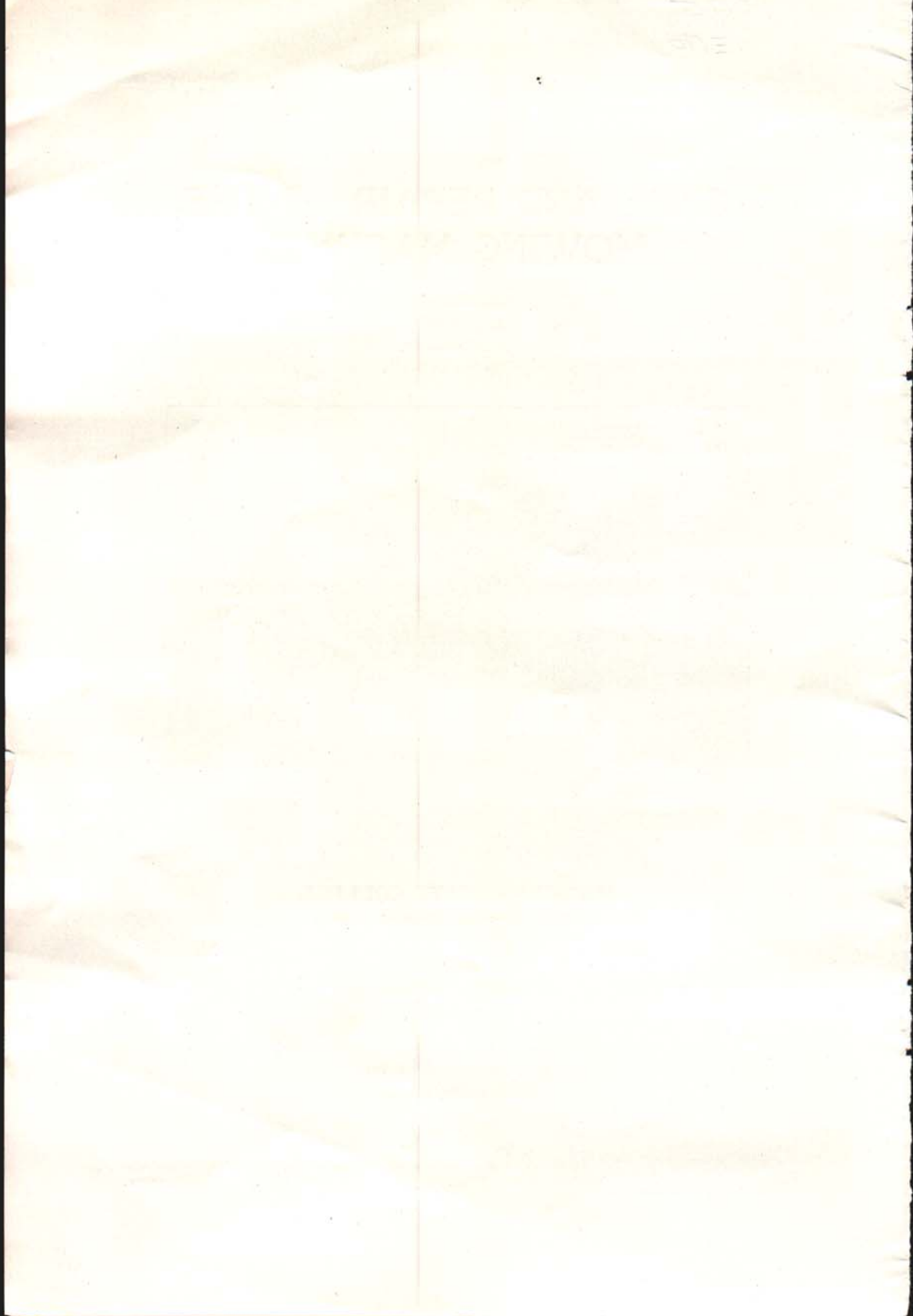


MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

EXTENSION DIVISION

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CARE AND REPAIR OF THE MOWING MACHINE

A. J. BELL

There is an investment of \$6,780,000 in mowing machines in Michigan. With an allowance of 8 per cent for depreciation, $3\frac{1}{2}$ per cent for interest on investment (based on 7 per cent annual rate) 2 per cent for repairs, and 2 per cent for taxes, housing, and insurance, a total of $15\frac{1}{2}$ per cent of the total annual investment is devoted to upkeep. At this rate, the annual upkeep is \$1,050,900. If this cost is reduced by timely repairs and adjustments by only 5 per cent the annual savings to Michigan farmers would be \$525,450.

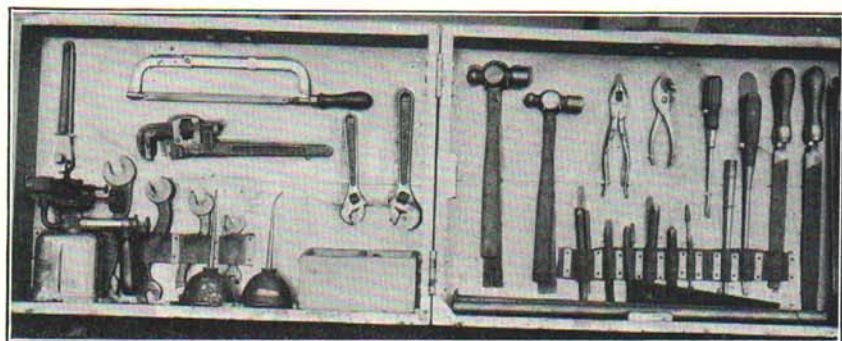


Fig. 1. A good set of tools.

Almost every farm has a mowing machine and, after a few years service, practically every mower needs more or less adjustment and repairs. The life of the new machine can be lengthened and the efficiency of old ones greatly improved by a few repairs and adjustments.

Every mowing machine, regardless of its age or make, has three things built into it, which are essential to its efficient operation. These three things are (1) alignment of the cutter bar, (2) register of the knives, and (3) shear.

Alignment

In order to keep the knife and pitman running in a straight line when the machine is cutting hay, the outer end of the cutter bar should be set ahead of the inner end. This distance increases with the length of the bar. The distance which the outer end is ahead of the inner end

is called "lead". The lead on a five-foot bar is one and one-half inches, on a six-foot bar one and three-fourths inches, and on a seven-foot bar two inches.

This lead is necessary because when the machine is cutting, the pressure of the hay forces the bar back. If the machine has lost its lead, the pressure of the hay forces the bar back, causes the pitman and knife to work on an angle at the knife head, and this frequently causes the knife to break at the knife head. The knife and pitman should work in a straight line and at right angles to the direction of travel.

To check the machine for lead, it is necessary to have the machine on a level floor and to raise the tongue to proper working height. This can be done by placing a support 32 inches long under the front end of the tongue. Tie a strong cord around a spoke of the left hand wheel from the outside, bring cord forward across the face of both wheels and along the cutter bar. Fasten the cord securely beyond the outer

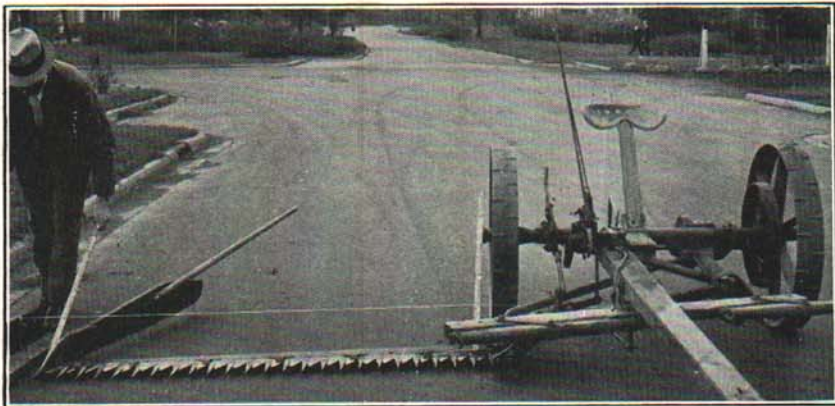


Fig. 2. Showing position of string for measuring amount of lead.

shoe. Be sure the cord is the same distance from the floor at both ends and that it just touches the face of the right hand wheel. Then pull the outer end of the cutter bar back as far as the wear will permit, and measure the distance from the cord to the back edge of the knife at the inner shoe, being careful to measure from the knife and not the knife head. Measure the distance from the cord to the back edge of the knife at the outer end and outside of the outer shoe. The back of the knife at the outer end should be the required distance farther from the string than it is at the inner end. Be sure the machine is on a level floor when making this measurement.

Some machines have an eccentric on the rear yoke pin. By turning this eccentric to the right or left, as the case may require, the lead is reestablished. On machines not equipped with an eccentric, the lead is reestablished by replacing the yoke and hinge pins with new ones (Deering) or by adjusting both the drag and the push bars by means of threads until both alignment and register are properly secured (McCormick).

Sometimes the lead may be regained by carefully shimming up the worn hinge pin holes with tin.

Register

The register of the knife means the relation between the guards and the knife on the extreme inner and outer ends of the stroke. When the knife is out or in as far as it will go, the point of the section should be in the center of the guard. If the length of the pitman or of the pitman straps has been changed, the knife will be out of register; that is, the point of the section will not travel into the guard as far as it should. When this happens, the knife does not cut all of the hay. Part of it is

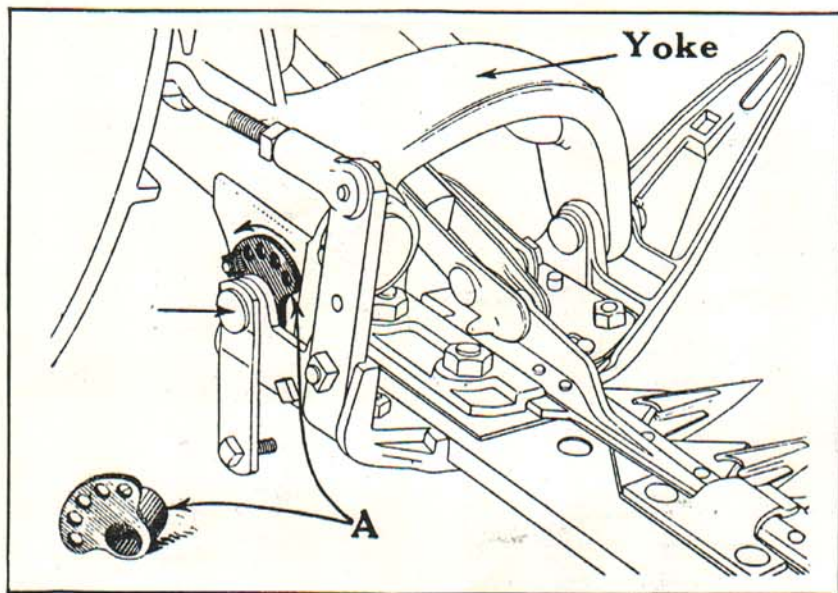


Fig. 3. One method of eccentric adjust for cutter bar lead.

cut and the rest pulled out. This results in increased draft, side draft, uneven cutting, and breaking the knife head. The knife may be registered by lengthening or shortening both the drag and the push bars. This moves the inner shoe and cutter bar out or in to meet the knife; or the length of the pitman may be changed by drilling new holes for the pitman straps. The old rivet holes should be plugged to prevent the wood from splitting out between them and the new holes.

Shear

The cutting action between the knife and the ledger plate is very similar to the shearing action of a pair of scissors with the knife acting as one blade of the shears and the ledger plate the other. The wearing plate and the knife holder act the same as the bolt in a pair of scissors. When the knife or ledger plates are dull or the knife holders and wear-

ing plates are worn, the hay is not sheared off cleanly. Fine, moist hay pulls in between the knife and the ledger plate and chokes the machine down. When in good adjustment and when the cutting parts are sharp, a machine should cut moist, fine hay almost as cleanly as hay that is in good condition for cutting.

When the ledger plates are worn so the serrated edges are smooth, they should be changed. They are held on the guard by a projection which fits into the guard at the front and by one rivet at the rear. This rivet may be punched out, and the old plate replaced with a new one. If the rest of the guard is in good condition the new ledger plate should make it as good as new.

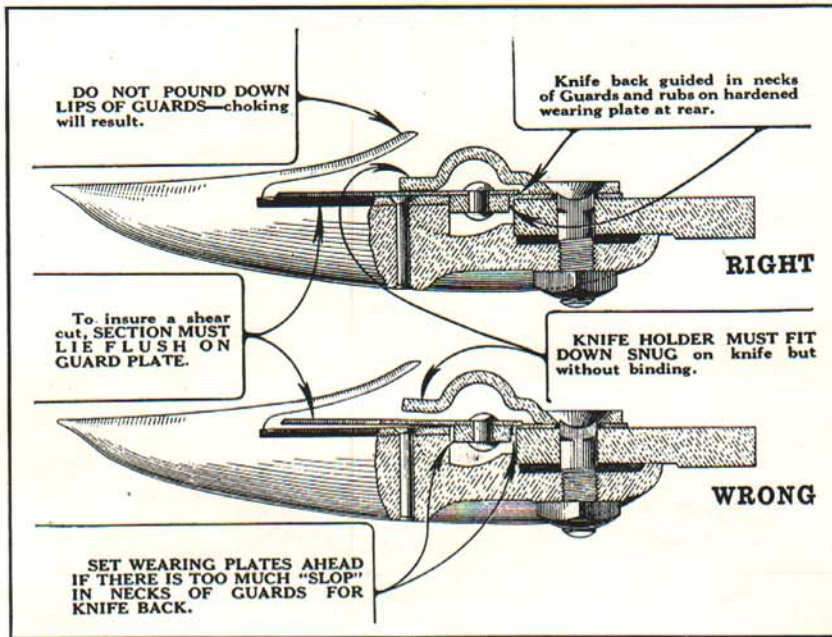


Fig. 4. Right and wrong adjustment of knife to ledger plate.

The wearing plates are the flat plates under the knife holders upon which the back of the knife rides. When this plate becomes worn the back of the knife drops down and the point comes up. It is then impossible to make the knives ride flat on the ledger plates. Wearing plates cost but a few cents and should be replaced when the old ones become worn.

Knife sections are no longer serviceable when they are cracked, broken, or ground down to a point. Old sections can be removed by placing the back of the knife on an iron block or anvil and striking the back edge of the section a sharp blow with a hammer. This will shear the rivets off without bending the knife-back. When putting on the new sections, be sure to get the rivets tight.

The knife holders are put on the machine to hold the knives on the ledger plates. When worn or bent upward, hay is pulled in between the knives and the ledger plates and the machine will choke down. A light blow with a hammer will bend the holder down and hold the knives on the ledger plates. This improves the shearing action of the knives.

Always take the knife from under the holder while tapping the holder down. After trying the knife to see if it is held down on the plate, remove the knife, tap the holder, then try the knife again. Do this until the holder is adjusted so the knife is held down without binding. The knife should lie flat on the ledger plate but still work freely.

It is necessary to align the guards to insure that each section lies flat on the ledger plate. The high guards should be driven down first and then the low ones driven up. This is done by striking the thick part of the guard a sharp blow with the hammer. Do not pay any attention to the points of the guards. Look at each guard plate to see that the knife is riding level and close to it and, if not, drive the guard up or down as may be necessary. The high guard holds the knives away from the ledger plates on each side of it. High guards should be driven down before the low ones are driven up.

Any cutter bar which has the proper lead, knife register, and a good shearing action should give satisfactory service if the rest of the mechanism is good enough to drive it.

Bearings

With few exceptions, the counter and crankshaft bearings are cast iron with babbitt linings. These bearings are replaceable.

To change the counter shaft bearings, remove the counter shaft, bevel gear, and spur gear, loosen set screws, if any, on the underside of the counter shaft bearings, and drive out the bearing with a heavy punch or short shaft. The new bearings are then driven in with a piece of hardwood and a hammer. If the new bearing fits too tightly, file or grind off the outside surface enough to permit proper seating of the bearing.

The pinion gear and crankshaft must be removed before the crankshaft bearings can be replaced. To remove the pinion gear from the shaft, insert a shaft or heavy punch through the spokes of the bevel gear; with another shaft, pry up on the wrist pin. Most pinion gears have a right hand thread, although some are opposite.

On some machines, it is necessary to remove the fly-wheel from the shaft before the shaft can be taken from the frame. To remove the fly-wheel, place the end of a three-fourth-inch shaft or heavy punch on the fly-wheel end of the crankshaft and drive the shaft through the wheel. The shaft can then be taken from the frame. Be sure the counter shaft and gears are removed before driving shaft through fly-wheel.

The bearings can be kept in line better if only one bearing is removed at a time. Take out one bearing and insert the new one before removing the other.

To remove the old bearing, insert a rod slightly smaller than the crankshaft, and, with a heavy hammer, drive out the lower bearing.

MOWING MACHINE

TROUBLE	CAUSE	REMEDY	PAGE
CHOKING DOWN	1-LAGGING CUTTER BAR	1- REESTABLISH LEAD,	3
	2-KNIFE OFF REGISTER	2- REGISTER KNIFE	5
	3-POOR LUBRICATION	3-LUBRICATE WITH GOOD OIL	6
	4- GUARDS LOOSE OR OUT OF LINE	4-ALIGN AND TIGHTEN GUARDS	6
	5-BAR TILTED TOO MUCH	5- LEVEL BAR	5
	6-WORN CUTTER BAR PARTS	6-REPLACE WORN PARTS	13
	7- BAR LIFTING PARTS OUT OF ADJUSTMENT	7- ADJUST BAR LIFTING PARTS	5
	8- KNIFE HEAD BOLTS LOOSE	8- TIGHTEN KNIFE HEAD BOLTS	7
	9- KNIFE HOLDERS NOT PROPERLY SET	9-ADJUST KNIFE HOLDERS	6
	10-LIPS OF GUARDS BENT DOWN	10- RAISE LIPS OF GUARDS	6
KNIFE AND KNIFE HEAD BREAKAGE	1- GUARDS LOOSE OR OUT OF LINE	1- ALIGN AND TIGHTEN GUARDS	7
	2-WORN KNIFE HEAD GUIDES & WEARING PLATE	2- REPLACE KNIFE HEAD GUIDES AND WEARING PLATES	6
	3-WORN KNIFE HEAD	3-REPLACE KNIFE HEAD WITH NEW	7
	4-WORN KNIFE HOLDERS AND WEARING PLATES	4- REPLACE KNIFE HOLDERS AND WEARING PLATES	5
	5- WARPED AND TWISTED PITMAN	5- REPLACE WITH NEW PITMAN	5
	6-PITMAN BOLTS TOO TIGHT OR TOO LOOSE	6- PITMAN SHOULD SWIVEL BUT HAVE NO END PLAY	3
	7- CROOKED KNIFE	7- STRAIGHTEN KNIFE OR REPLACE WITH NEW ONE	4
	8-DULL KNIFE AND LEDGER PLATES	8- REPLACE SECTIONS AND LEDGER PLATES WITH NEW	13
	9- WORN PITMAN BOXING	9- REPLACE WITH NEW	5
	10-KNIFE OFF REGISTER	10-REGISTER KNIFE	3
	11-LAGGING CUTTER BAR	11- REESTABLISH LEAD	4
	12-POLE CARRIED TOO LOW	12-UNDERSIDE OF POLE AT NECK-YOKE SHOULD BE 32" FROM GROUND	13
	13-BAR TILTED TOO MUCH	13-RUN BAR MORE LEVEL	7
SIDE DRAFT AND UNEVEN STUBBLE	1- GUARDS LOOSE OR OUT OF LINE	1- ALIGN AND TIGHTEN GUARDS	6
	2-DULL, BROKEN OR LOOSE GUARDS & SECTIONS	2-REPLACE GUARD PLATES & SECTIONS WITH NEW	5
	3-WORN KNIFE HEAD GUIDES, KNIFE HOLDERS OR WEARING PLATES	3-REPLACE KNIFE HEAD GUIDES, KNIFE HOLDER & WEARING PLATES WITH NEW	13
	4-NOT ENOUGH TENSION ON LIFTING SPRING	4-TIGHTEN LIFTING SPRING	5
	5-KNIFE OFF REGISTER	5-REGISTER KNIFE	13
	6-BAR LIFTING PARTS OUT OF ADJUSTMENT	6-ADJUST BAR LIFTING PARTS	5

TROUBLE CHART

TROUBLE	CAUSE	REMEDY	PAGE
HEAVY DRAFT	1- POOR LUBRICATION	1- LUBRICATE WITH GOOD OIL	3
	2- LAGGING CUTTER BAR	2- REESTABLISH LEAD	5
	3- WORN KNIFE HEAD GUIDES, KNIFE HOLDERS OR WEARING PLATES	3- REPLACE WITH NEW PARTS	5
	4- KNIFE OFF REGISTER	4- REGISTER KNIFE	6
	5- GUARDS LOOSE OR OUT OF LINE	5- ALIGN & TIGHTEN GUARDS	6
	6- DULL, BROKEN OR LOOSE SECTIONS OR GUARD PLATES	6- REPLACE SECTIONS OR GUARD PLATES WITH NEW	6
	7- KNIFE HOLDERS BINDING	7- FREE KNIFE HOLDERS SLIGHTLY	6
	8- NOT ENOUGH TENSION ON LIFTING SPRING	8- TIGHTEN LIFTING SPRING	13
	9- POLE CARRIED TOO LOW	9- UNDERSIDE OF POLE AT NECKYOKE SHOULD BE 32" FROM GROUND	4
	10- GEARS MESH TOO DEEPLY	10- REMOVE WASHER FROM BETWEEN GEARS	11
	11- BAR TILTED TOO MUCH	11- RUN BAR LEVEL	13
PITMAN BOX AND CRANKSHAFT BOXES HEATING	1- WRIST PIN CROOKED IN FLYWHEEL	1- SET WRIST PIN SQUARELY IN FLYWHEEL	7
	2- PITMAN BOX TOO LONG OR CROOKED WRIST PIN NUT	2- REPLACE WITH PROPER PITMAN BOX & GOOD NUT	7
	3- POOR LUBRICATION	3- LUBRICATE WITH GOOD OIL	
	4- WARPED OR CROOKED PITMAN	4- REPLACE WITH NEW PITMAN	
	5- PITMAN BOX BOLT TOO TIGHT	5- LOOSEN PITMAN BOX BOLT	
	6- DIRT OR METAL IN BEARING	6- REMOVE DIRT OR METAL	
	7- CRANKSHAFT BEARINGS OUT OF LINE	7- REPLACE WITH NEW AND LINE	7
	8- CRANKSHAFT SPRUNG	8- REPLACE WITH NEW	
	9- CUTTER BAR IN NEED OF REPAIR	9- OVERHAUL AND ADJUST CUTTER BAR	5,6,7

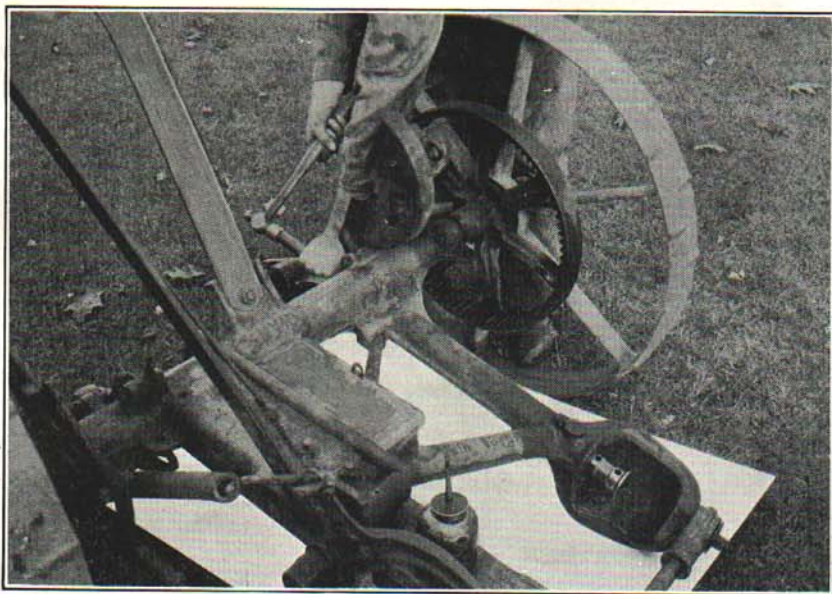


Fig. 6. Removing lower bearing.



Fig. 7. Replacing lower crankshaft bearing. Fly-wheel removed.

Slip the new bearing over the crankshaft and insert in the frame. This guides the bearing and keeps it in line. Drive the bushing into the frame by striking a hardwood block held against the fly-wheel or crankshaft if the fly-wheel has been removed from the shaft. Keep turning the shaft to insure proper lining of the bearing.

To remove the upper bearing, insert the rod through the lower bearing and strike with the hammer forcing out the upper bearing in the same manner that the lower bearing was removed. To replace, insert the crankshaft in the frame, slip the new bearing over it and drive in place with a hammer and hardwood block.



Fig. 8. Removing fly-wheel.

CAUTION: Always replace the new bearings over the crankshaft, do not remove both bearings at the same time, and keep turning the crankshaft while driving in the new bearing. Otherwise, the bearings may get out of line.

Gears

The pinion and bevel gears should be adjusted so the teeth mesh full depth without binding. If they mesh too deeply or not deeply enough, they will wear rapidly. There should be very slight clearance between the two gears.

There are two ways of adjusting these two gears. If the crankshaft has end play, a washer can be placed between the frame and the pinion gear. Because of the taper of the pinion gear, this tends to mesh the gears deeper and also removes the end play. If there is no end play, the gears are meshed deeper by placing steel washers between the

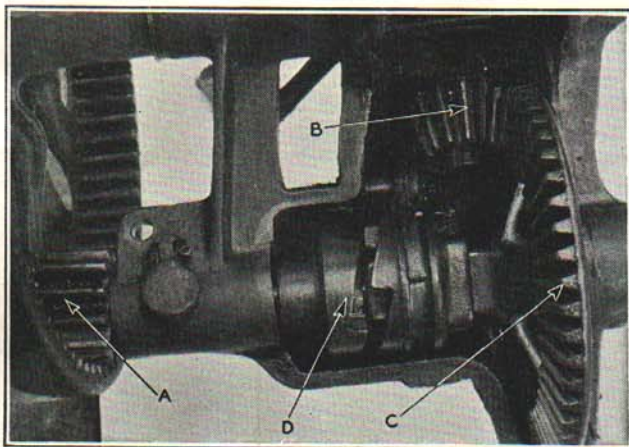


Fig. 9. Gear assembly Deering Mower.

- A. Spur gear
- B. Pinion gear
- C. Bevel ring gear
- D. Clutch

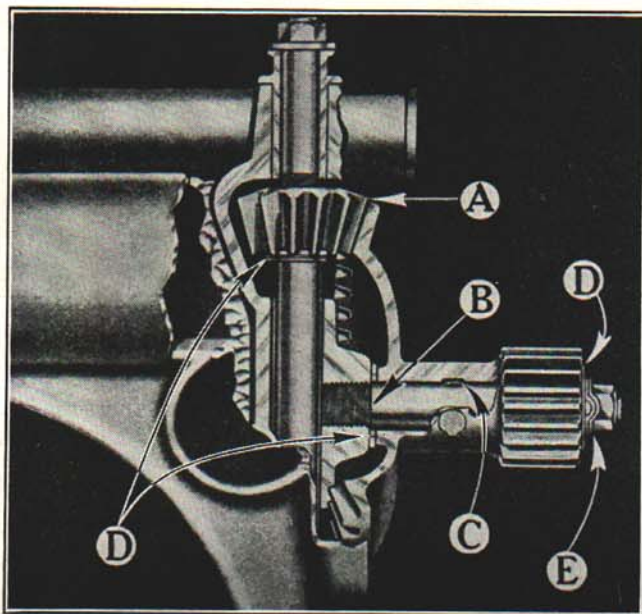


Fig. 10. Gear assembly John Deere Mower.

- A. Bevel pinion screws on shaft L.H. thread
- B. Bevel gear stud screws in frame L.H. thread
- C. Hole provided for punch to tighten or loosen stud
- D. Washers added or removed to properly mesh gears
- E. Lock washer

frame and the spur gear. This moves the bevel gear nearer to the pinion gear.

Some machines have a thrust nut on the end of the countershaft which, when tightened, draws the bevel gear into the pinion gear and meshes them deeper. By adjusting this nut, the gears can be meshed to the proper depth. Noisy gears indicate they are meshed too deeply, and may be properly adjusted by loosening the thrust nut. Fig. 10 shows the method of adjustment of gears on a Deere Mower.

Lifting Levers and Spring

Most mowers are equipped with three levers, a hand lifting lever, a foot lifting lever, and a tilting lever.

The hand lifting lever raises the cutter bar high off the ground. Usually this throws the machine out of gear. On the regular lift machines, this lever raises the bar approximately three feet off the ground. On the vertical lift machines, the bar raises to a vertical position.

The foot lifting lever does not raise the bar as high as the hand lever. The foot lever is used while the machine is operating to lift the bar over stones and stumps or when turning corners. The bar is again lowered to the ground by removing the pressure from the lever.

The tilting lever is used to tilt the cutter bar either up or down. This effects the length of the stubble. The more it is tilted down, the shorter the stubble will be. Ordinarily, the bar is run parallel to the ground.

The lifting spring performs two duties. Primarily, it prevents the inner shoe from riding the ground too hard. The spring should be so adjusted that the inner shoe will float along the ground. If the tension on this spring is not great enough, the inner shoe rides the ground, thereby, adding to the draft, and throwing considerable side draft into the machine. If the tension is too great, the inner shoe will have a tendency to hold up after passing over a stone or other obstruction. The spring should be loose enough to allow the inner shoe to drop back to the ground and tight enough to prevent the bar from riding heavily on the ground. This spring also makes it easier for the operator to raise the bar.

Wrist Pin

After a few years' wear, the wrist pin becomes worn and is oval in shape. When this happens, a new pitman box does not fit properly and soon wears out. It is difficult to see when a wrist pin is worn. If the new pitman box is loose on the pin, it should be changed. To remove the old pin, file or chisel the riveted end and drive the pin out. In replacing the new pin, care should be taken to see that the shoulder seats on the fly-wheel all the way around. This insures that it is perpendicular to the fly-wheel. Unscrew the nut part way to prevent damage to the threads, turn the wheel up, and place the nut end of the pin on an anvil or heavy iron. With the heavy cold chisel, cross cut deeply the end of the pin and then rivet until tight.

Pawls

Once each year, the wheels should be removed and the pawls and springs inspected to make sure they are doing their proper work. Worn pawls are apt to leave their places and cause excessive wear in the ratchets and pawl holder. As the ratchets are a part of the wheel, it is an expensive repair if the ratchets become worn enough to let the pawls slip over them.

Wheels

Excessive end play in the wheels allows the pawls to lean outward. This causes uneven wear of the pawls and pawl holder, and may ruin the ratchets. This end play can be taken up by the take-up washer on the outer end of the wheel hub or by placing steel washers between the take-up washer and the hub.

Acknowledgment

Figures 3, 4, and 10 are used by courtesy of the John Deere Company.

