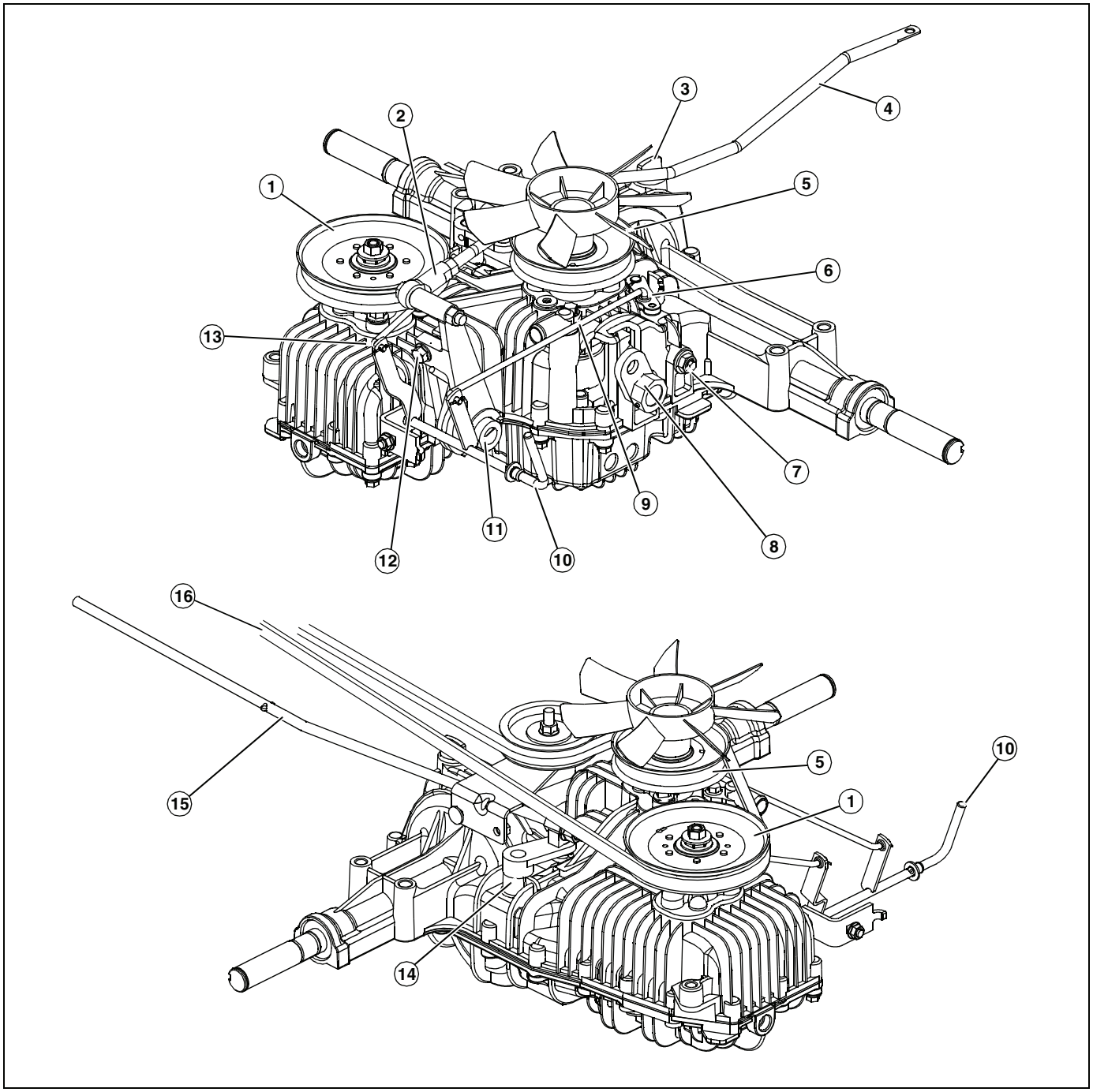
Component Location

Transaxle



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1 - Steering Pump Input Sheave
2 - Steering Control Rod Adjuster
3 - Gear Compartment/Oil Fill Cap
4 - Steering Control Rod (Rear)
5 - Traction Control Pump Input Sheave
6 - Traction Control Dump Valve
7 - Eccentric Shaft (Propel Neutral Adjustment)
8 - Propel Control Arm
9 - Traction Control Dump Valve Rod
10- Tow Valve Lever
11- Steering Control Shaft
12- Tracking Adjustment Bolt
13- Steering Control Dump Valve Rod
14- Brake Input Shaft
15- Brake Rod
16- Drive Belt

Theory Of Operation

Components Covered:

- Traction Drive Belt System
- Transaxle and Shift Pedal Linkage System
- Transport (Free-Wheeling System)

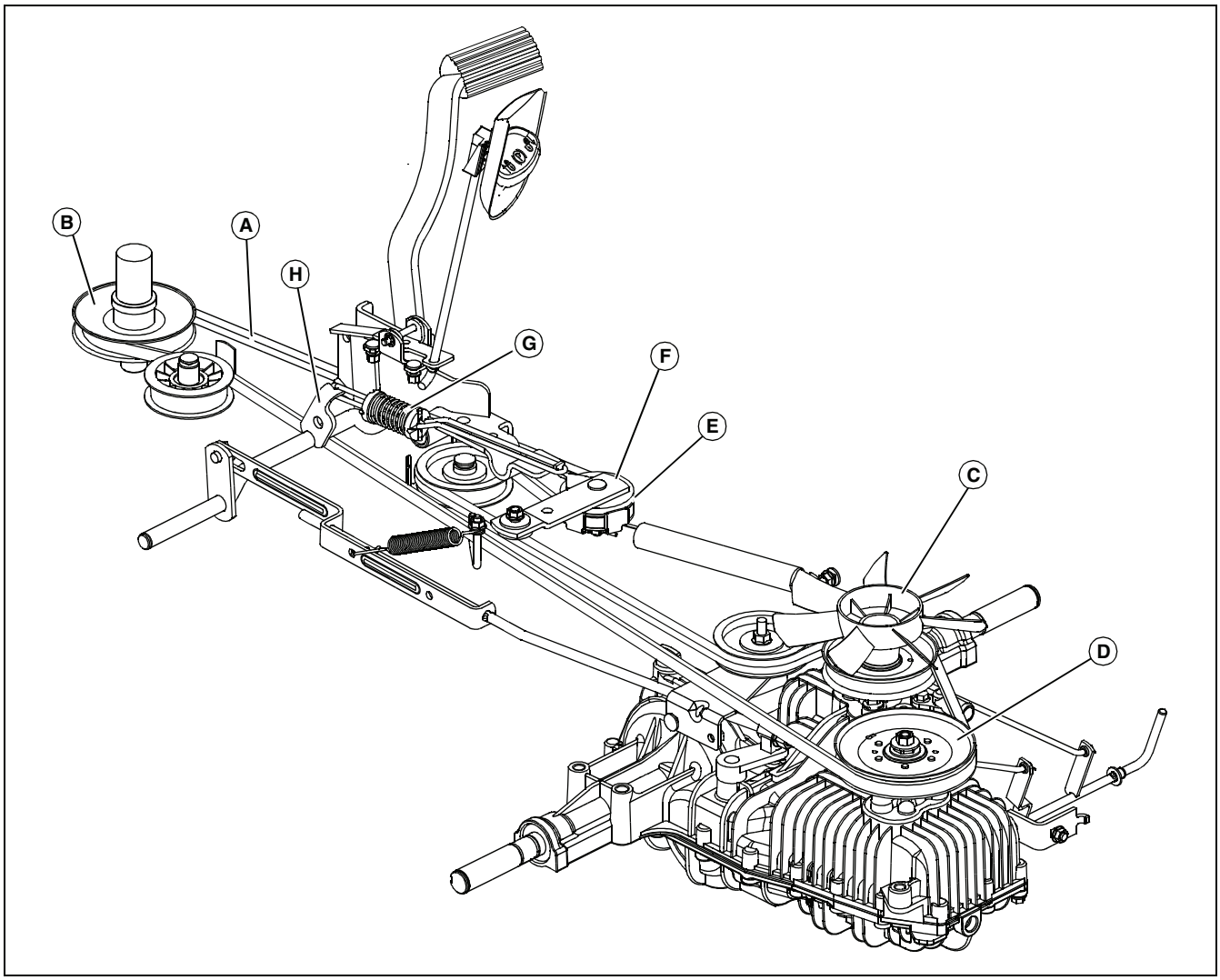
Traction Drive Belt System

Function:

The traction drive belt transfers power from the engine to the input pulley of the hydrostatic transaxle.

Theory of Operation:

- The traction drive belt (A) is driven by the upper pulley of the engine drive sheave (B).
- The traction belt then transmits engine power to the two input pulleys (C and D) of the hydrostatic transaxle.
- The traction drive belt is tensioned by the pivot idler (E), which is mounted on a spring loaded bracket (F). The pedal return spring (G) hooks to the brake pedal shaft arm (H).



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The drive belt (A) turns the transaxle propel input pulley (C) and transaxle steering pulley (D) which drive the transaxle's hydrostatic pumps. When the hydrostatic drive is in neutral, no pressure is built up in the pumps. When the operator engages the forward or reverse pedals, the drive linkage tilts the propel swash plate inside the transaxle off center, and the pump pistons build pressure which drives the hydrostatic motor. The motor drives the rear axles and wheels.

Transaxle And Shift Pedal Linkage System

Function:

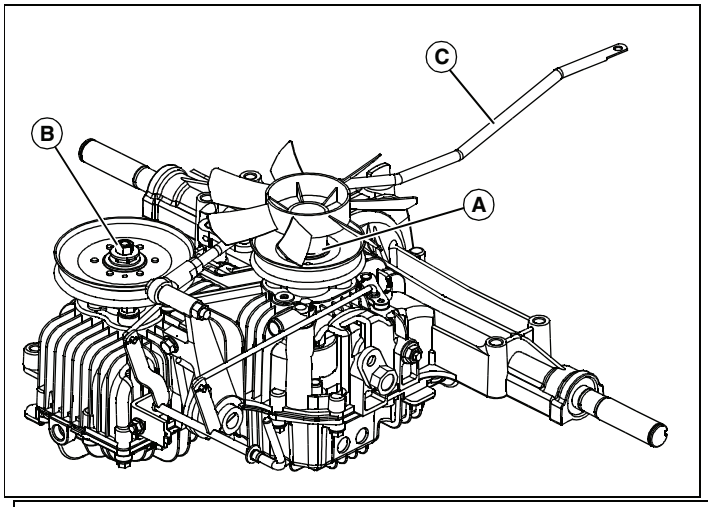
The function of the transaxle is to transfer power from the traction drive belt system (driven by the engine), to the rear wheels, and allow the operator to select ground speed and direction.

Braking the tractor declutches the drive belt, stopping the belt and input pulleys. Braking also rotates the transaxle brake lever which applies braking pressure to an internal wet brake

The transaxle provides infinite ground speed selections from 0 to 9 km/h (0 to 5.6 mph) in forward and from 0 to 5 km/h (0 to 3.1 mph) in reverse.

Theory of Operation:

Neutral:



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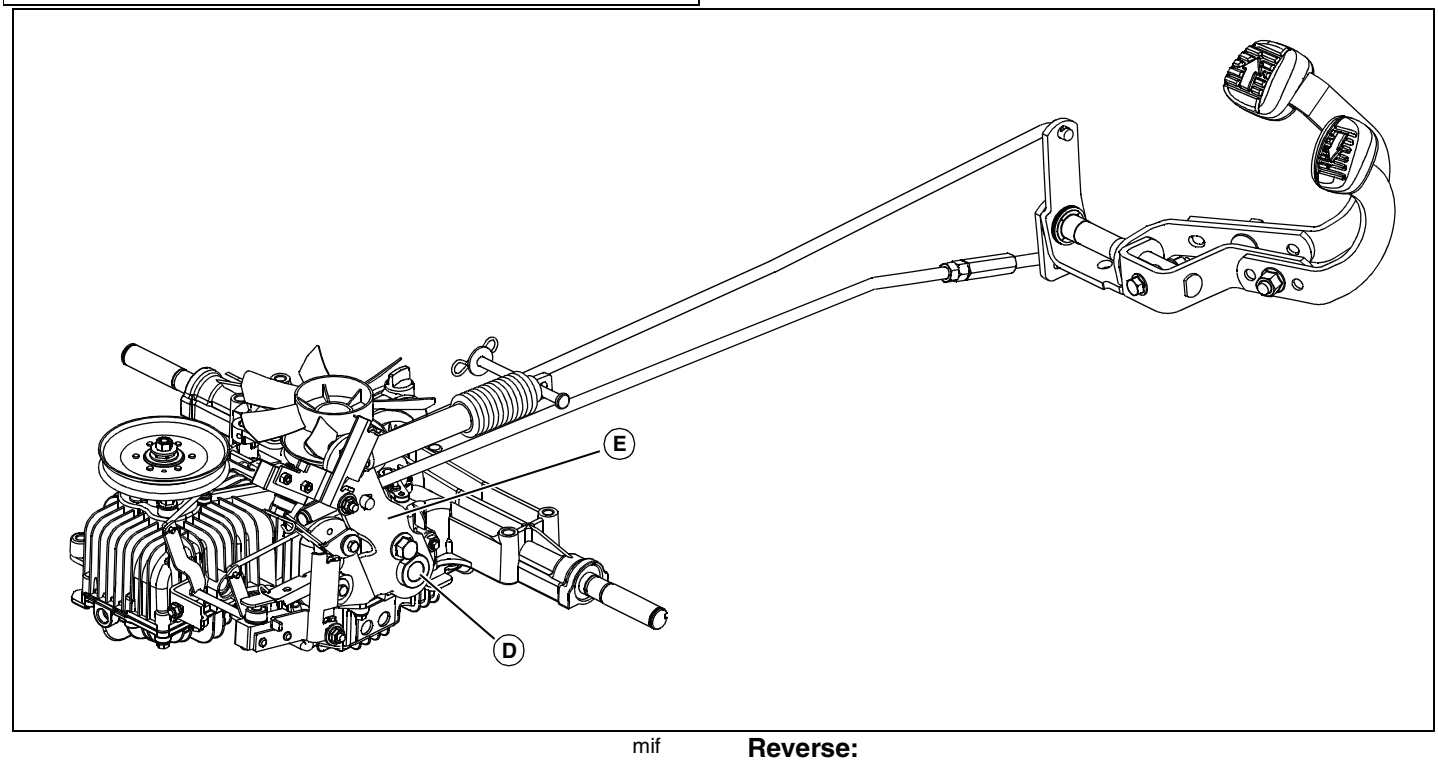
- When the engine is running and the brake is released, the traction drive belt turns the transaxle propel input shaft (A), and steering input shaft (B). The input shafts turn the hydrostatic propel pump and steering pump.
- When the steering wheel is in the neutral position the rear steering rod (C) is spring centered and the steering shift lever (D) is in the neutral position.
- When the forward/reverse pedals are in the neutral position the propel input shaft (D) is in the neutral position and the drive axles do not turn.

Forward:



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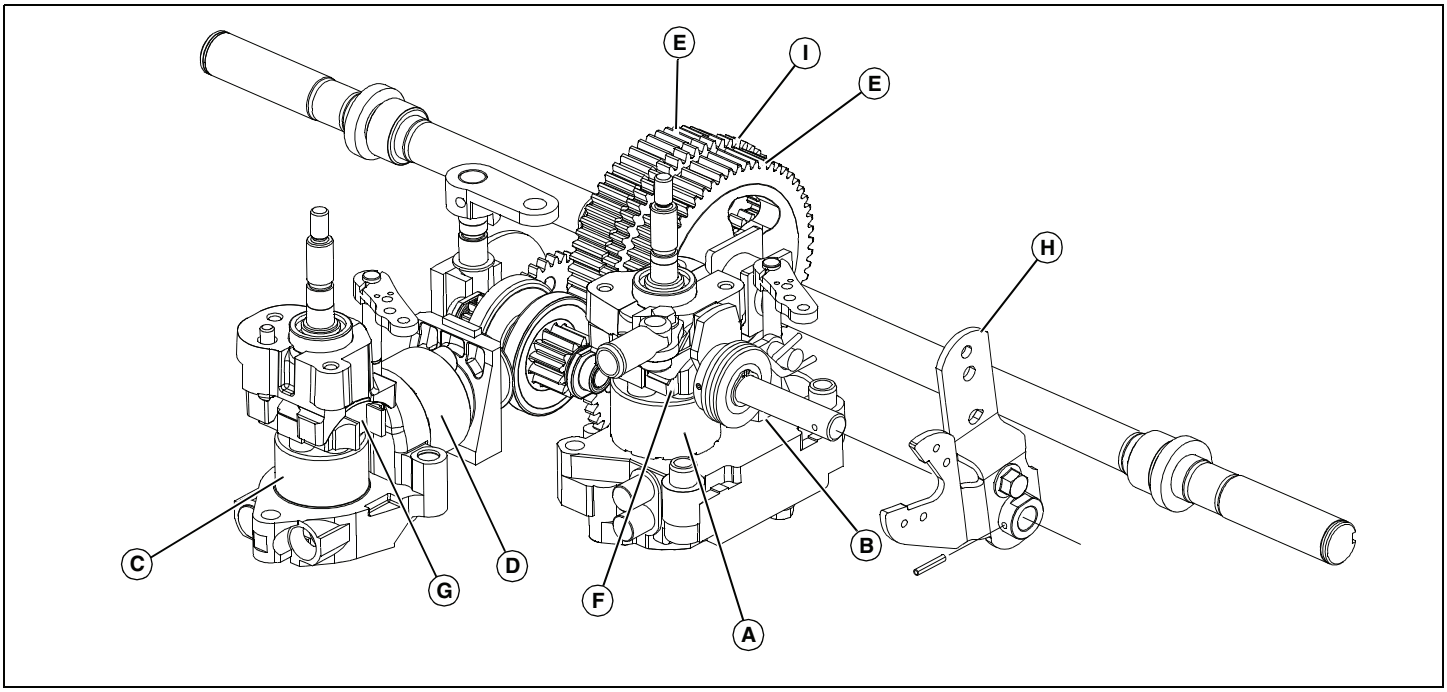
- When the forward pedal is depressed, the shift linkage moves the transaxle arm (E) forward turning the shifter shaft and causing the drive axles to turn in the FORWARD direction.

Reverse:

- When the reverse pedal is depressed, the shift linkage moves the transaxle arm (E) rearward turning the shifter shaft and causing the drive axles to turn in the REVERSE direction.

Transaxle Operation



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Hydrostatic Pumps and Motors

The transaxle contains two hydrostatic pumps and motors. The propel pump (A) and motor (B) provide power to the gear drive components which drive the axles. The steering pump (C) and motor (D) provide power to drive the ring gears (E) that control the speed of rotation of each axle.

The pumps have variable displacement swash plates and the motors have fixed displacement swash plates.

The propel and steering pumps are driven by the main drive belt and are rotating clockwise (viewed from top) any time the engine is running and the brake is released (drive belt has tension). Each pump and motor set can be operated independently of the other.

As long as the forward and reverse pedals are released, the variable displacement swash plate (F) in the propel drive pump is spring centered and level with pistons in the drive pump (A). If the drive pump is rotating and the swash plate is level, the pistons in the pump are not pumping oil.

As long as the steering wheel is not turned, the variable displacement swash plate (G) in the steering pump is spring centered and level with pistons in the steering pump (C). If the steering pump is rotating and the swash plate is level, the pistons in the pump are not pumping oil.

Forward Propel Control

When the forward pedal is pressed, the propel control arm (H) on the transaxle is rotated forward. The rotation angles the variable displacement swash plate (F) within the transaxle.

Springs inside the pump pistons force them against the swash plate. As the piston block rotates and the pistons follow the contour of the swash plate they move outward drawing oil into their bores. As the piston block continues to rotate, the swash plate angle forces the pistons back into the bores and displaces the oil through the porting in the valve body. The farther the swash plate rotates, the farther the pistons move and more oil is pumped.

High pressure oil from the pump forces the forward check valve closed and supplies high pressure oil to the drive motor rotating group.

The motor rotating group works with a fixed displacement swash plate. High pressure oil enters the piston bore through a port in the valve plate at a point where the piston is compressed in its bore.

As the oil fills the piston bore, the piston is forced out and follows the contour of the fixed swash plate. This creates the rotary motion in the motor rotating group for the forward drive. The piston continues to move out of its bore and follow the fixed angle swash plate until it is no longer aligned with the delivery port of the valve body. Since oil is no longer being displaced to the piston, it no longer adds to the rotary motion of the motor. But, the next piston in line is filling with oil and the rotary motion is continued.

As the motor group continues to rotate, its pistons are compressed by the fixed angle swash plate and oil is forced from the piston bores.

The motor output shaft is splined to the motor and rotates in the same direction as the piston block. A machined gear on the output shaft meshes directly with the bull gear (I).

Reverse Propel Control

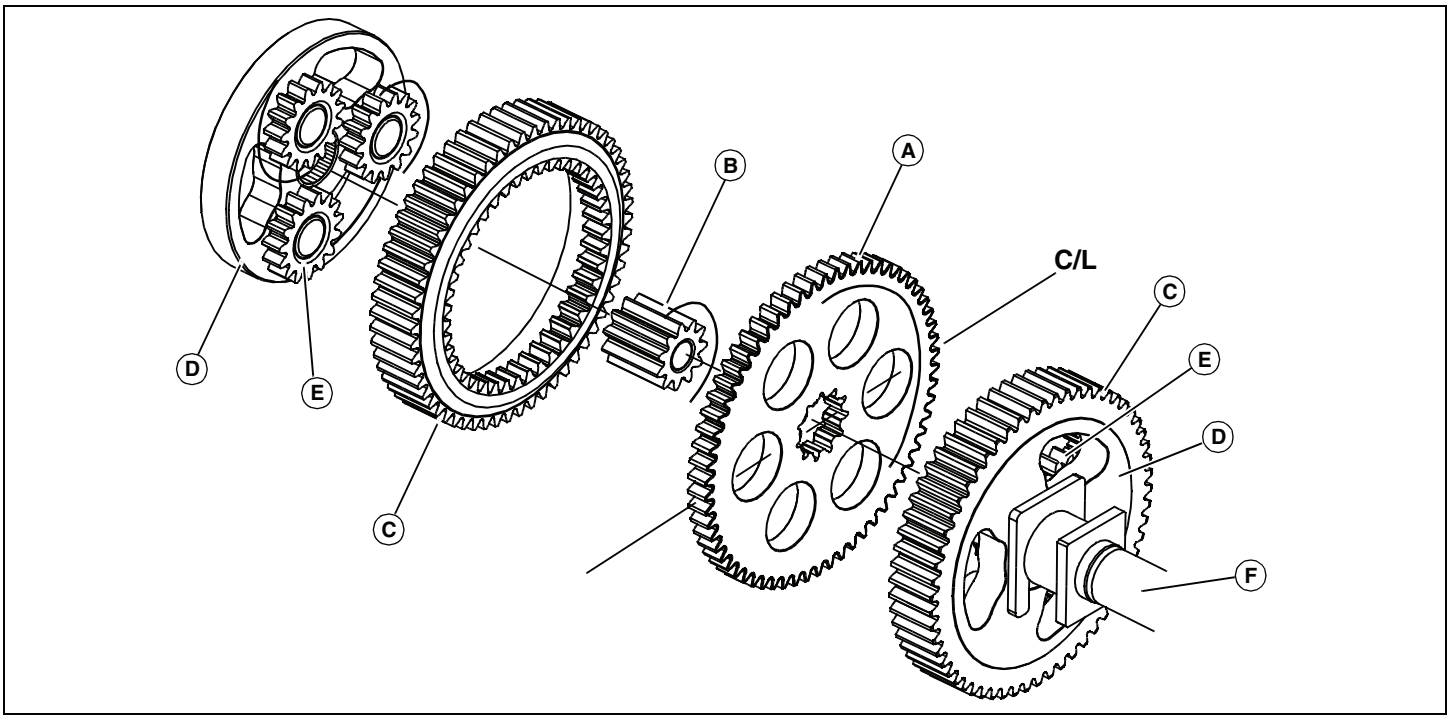
When the reverse pedal is pressed, the propel control arm on the transaxle is rotated rearward. The rotation angles the variable displacement swash plate (F) within the transaxle.

The rotation of the pump group is still clockwise, with the variable displacement swash plate rotated in the opposite direction from forward rotation angle. Because the reciprocating movement of the pistons is happening on the opposite sides, the oil is moving in and out of opposite ports.

High pressure oil from the pump forces the reverse valve closed and supplies high pressure oil to the drive motor group. The oil path from the motor to the pump is switched which gives opposite rotation to the motor rotating group.

The opposite rotation of the motor body rotates the output shaft in the opposite direction of forward rotation. The machined gear on the output shaft rotates the bull gear in the opposite direction it turns when in forward.

Propel Gear Drive Component Operation



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The gear components transfer power from the hydrostatic components of the transaxle to the drive axles.

The propel gear assembly is made up of a bull gear (A) with a sun gear (B) and two identical ring gears (C), carriers (D) and three planetary gears (E) mounted on each carrier.

The propel hydrostatic motor output shaft has a machined gear that meshes with the bull gear (A). The sun gear (B) is splined into the center of the bull gear. The sun gear is constantly engaged to the six planet gears (E).

During forward or reverse drive, without turning the steering wheel, the ring gears (C) are held stationary and do not rotate. As the propel hydrostatic motor rotates, the output shaft turns the bull gear and sun gear. The sun gear rotates the planet gears. The planet gears “walk” around the inside of the stationary ring gears and turn the carriers.

The axles (F) are splined directly to the center of the carriers. As the carriers rotate inside of the stationary ring gears, the axles (and rear wheels) rotate at the same speed and propel the tractor.

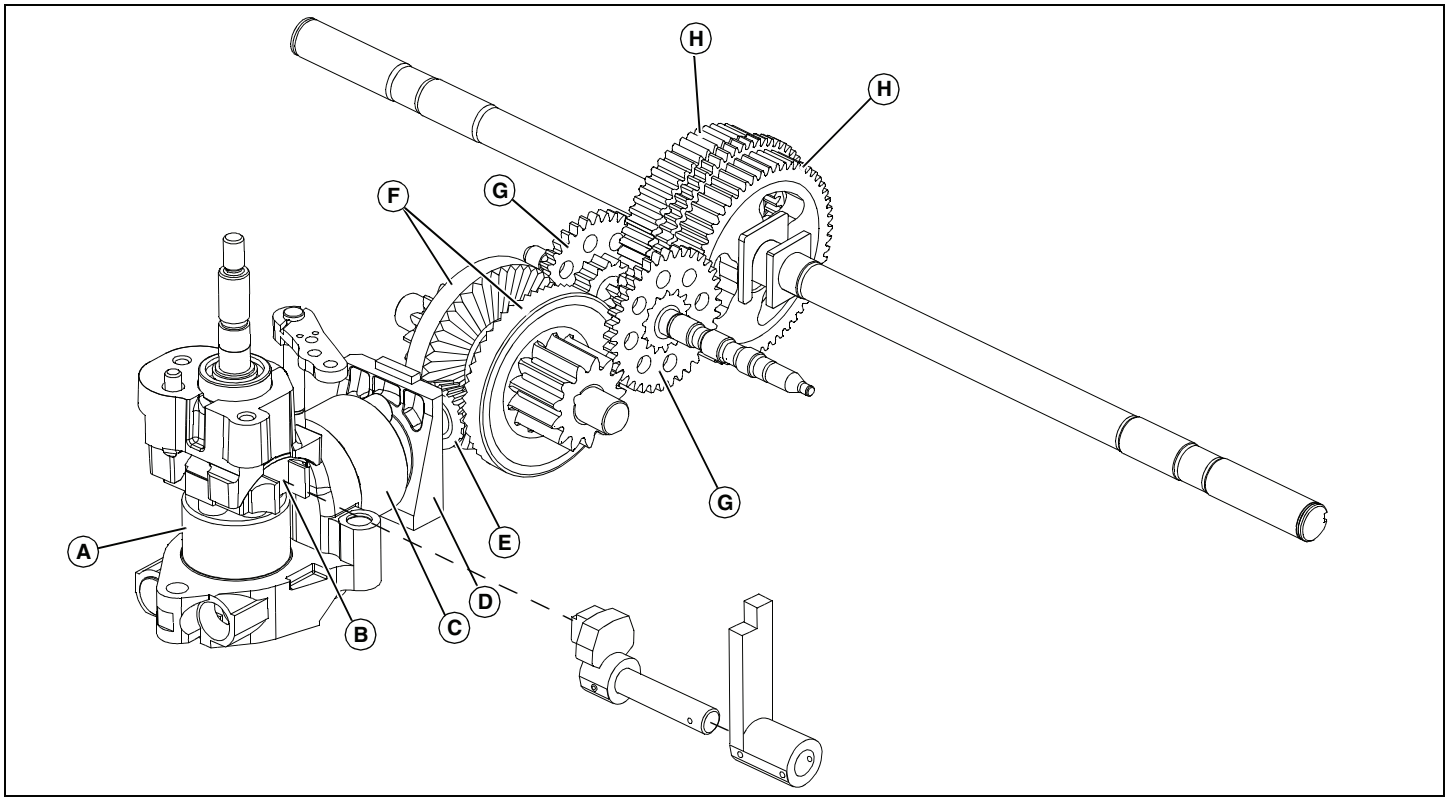
When the ring gears are driven by the steering hydrostatic component, they rotate in opposite directions. (See “Steering Control” on the next page.) When a ring gear rotates in the opposite direction that the planet gears are “walking” around its inside, the slower the rotation of the carrier and axle. If the ring gear rotates in the same direction that the planet gears are “walking” around its inside, the faster the rotation of the carrier and axle.

Because the ring gears rotate in opposite directions, any ring gear rotation causes one axle to slow down and the other axle to speed up causing the tractor to turn. The faster the ring gears rotate, the greater the difference in the axle speeds and the faster the tractor turns.

The slower that the planet gears are “walking” around the ring gears, the greater the effect that ring gear rotation will have, and the faster the turn response will be.

With minimal planet gear rotation, the opposite rotation of the ring gears causes maximum opposite rotation of the axles and a “zero” turn condition.

Steering Control



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The steering control group consists of the steering hydrostatic pump and motor, and gear components. The function of the steering group is to control the speed and direction of rotation of the two ring gears.

The steering wheel, sector and gear, steering rods and vacuum system control the transaxle steering control lever. NOTE: The vacuum system will NOT operate unless either the forward or reverse pedal is pressed, and the steering control lever will NOT rotate. (See “Theory of Operation” in the Steering section.)

The steering pump (A) is continuously rotating when the engine is running and the brake is off.

As long as the steering wheel is not turned, the variable displacement swash plate (B) in the steering drive pump is centered and level with pistons in the steering pump (C). If the drive pump is rotating and the swash plate is level, the pistons in the pump are not moving and no oil is being pumped.

The steering control lever and shaft control the angle of the steering pump variable swash plate.

Springs inside the pump pistons force them against the swash plate. As the piston block rotates and the pistons follow the contour of the swash plate they move outward drawing oil into their bores. As the piston block continues to rotate, the swash plate angle forces the pistons back into the bores and displaces the oil through the porting in the valve body. The farther the swash plate rotates, the farther the pistons move and more oil is pumped.

When the steering wheel is turned, the steering control arm on the transaxle is rotated either forward or rearward. The rotation angles the variable displacement swash plate (B) within the transaxle.

High pressure oil from the pump forces the check valve closed and supplies high pressure oil to the steering motor rotating group.

The motor rotating group (C) works with a fixed displacement swash plate (D). High pressure oil enters the piston bore through a port in the valve plate at a point where the piston is compressed in its bore.

As the oil fills the piston bore, the piston is forced out and follows the contour of the fixed swash plate. This creates the rotary motion in the motor rotating group for steering control. The piston continues to move out of its bore and follow the fixed angle swash plate until it is no longer aligned with the delivery port of the valve body. Since oil is no longer being displaced to the piston, it no longer adds to the rotary motion of the motor. But, the next piston in line is filling with oil and the rotary motion is continued.

As the motor group continues to rotate, its pistons are compressed by the fixed angle swash plate and oil is forced from the piston bores.

The motor output shaft is splined to the motor and rotates in the same direction as the piston block. A beveled gear

(E) on the output shaft meshes directly with two counter gears (F). The counter gears are mounted on a short countershaft and turn independently of each other.

The counter gears mesh with two sets of idler/reduction gears (G). The idler/reduction gears engage the ring gears (H).

Rotation of the steering motor drives the counter wheels in opposite directions which rotates the ring gears in opposite directions.

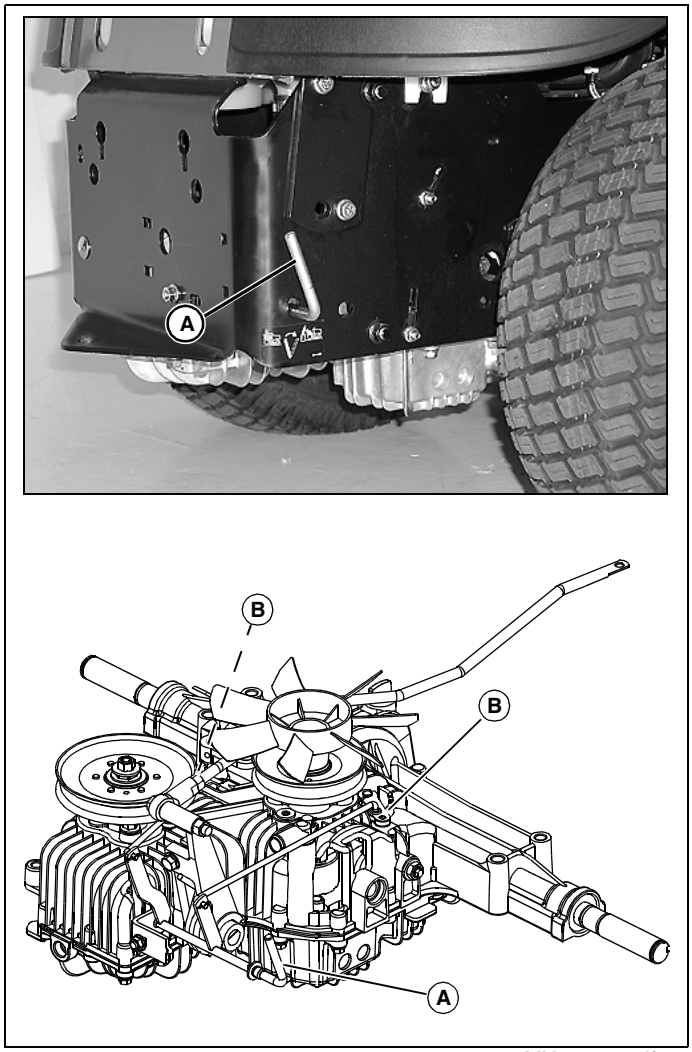
Transport (Free-Wheel) System

Function:

The transport (Free-wheel) system allows the operator to push the tractor forward or reverse with the engine off and the brake released.

CAUTION: Avoid injury! DO NOT operate freewheel valve with engine running or damage to hydrostatic transmission can occur.

Theory of Operation:



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- When the free wheel handle (A) is rotated forward to its locked position, the free wheel rod rotates the actuating shafts (B) on the transmission.
- When the actuating shafts rotate, the transmission hydraulic motors are raised slightly from their sealing plate relieving hydraulic pressure, and the operator is allowed to push the tractor in forward or reverse with the engine off and the brake released.

Diagnostics

Propel Troubleshooting

Test Conditions:

- Tractor on level surface
- Front wheels blocked
- Engine OFF

Test/Check Point	Normal	If Not Normal
Fan	Fan in good condition and tight	Tighten fan. Repair or replace
Drive belt	Belt in good condition, not glazed, split, unraveled, or stretched	Replace drive belt.
Sheaves and idlers, belt traction drive system	Drive sheaves and idlers in good condition and adjusted properly Belt not slipping, squealing, or vibrating excessively	Adjust idler assembly. Repair or replace Check belt condition, check adjustment and condition of idlers and guides. Adjust, repair or replace components as needed.
Transaxle housing exterior	No cracks, leaks, or loose hardware	Tighten hardware. Replace transaxle. Replace any damaged components.
Axles	Axles straight	Replace as needed.
Wheels and tires	Air pressure equal in driving tires Driving tires have same circumference Wheels not bent or out of round	Adjust air pressure. Match tires for same circumference. Repair or replace wheels as necessary.

Test Conditions:

- Engine running
- Machine on level ground
- Operator ON the seat
- PTO/RIS switch in OFF position

Test/Check Point	Normal	If Not Normal
Engine performance	Engine running smoothly throughout throttle range	Adjust, tune, or repair engine.

Test/Check Point	Normal	If Not Normal
Drive machine forward and reverse	Machine moves in the appropriate direction without drifting left or right (40 ft with 4 ft or less drift)	If machine tracks left or right check tire pressure and adjust steering tracking. See “Steering Troubleshooting” Section If machine does not move, check for proper fluid level in transaxle. Drive belt for condition, routing and proper tension. Check transaxle input pulley for security of attachment. Check free wheeling lever for correct position and proper operation. Check brake for complete disengagement and proper operation. Check propel rods and levers for attachment and proper operation If all the above items are satisfactory, replace transaxle assembly.
Drive machine forward and reverse in full speed and record time over a predetermined distance.	In forward, 2.5 meters/sec (8.2 ft/sec) In reverse, 1.4 meters/sec (4.5 ft/sec)	Check tires for proper pressure and size. Check forward and reverse pedals for proper operation, full travel, and adjustment. check drive belt for condition, routing and proper tension. Check brake for complete disengagement. Check free wheeling lever for correct position and proper operation.