# Honda 4 Wheel Steering

Last month in this department, we talked about a computerized automatic transmission. And while computers are invading on every front, we occasionally see some ingenious engineering that doesn't rely on a microprocessor.

Honda has introduced a purely mechanical four-wheel steering system. No wires, bells, or whistles.

The system in question uses one of the oldest contrivances known to the automotive world—the planetary gear. Henry Ford used it in the Model T. Automatic transmissions wouldn't be the same without it.

The planetary gear allows Honda to convert rotational inputs from a steering shaft into lateral movement of a rear steering gear. As the planetary gear rotates within a fixed gear housing, it moves a slider from side to side and steers the rear wheels.

## Why Bother?

Why bother with four-wheel steering, you ask? After all, we've steered with the front wheels alone for years and done quite well. Haven't we?

To understand the advantages of four-wheel steering over conventional two-wheel guidance systems, we need to understand how each works. For instance, when you turn the wheels on a front-steer car, the movement of the steer wheels away from the thrust line of the vehicle causes a lateral, or sideways, movement of the body. It wants to rotate slightly like a pig on a spit. This movement is called *yaw.* You may remember the terms pitch and yaw from the old space capsule flights. Unfortunately, it takes time for this yawing motion to catch up with the change in direction. However, if all the wheels steer together the delay in direction change is lessened. The rear of the car steers *with* the car instead of simply tagging along.

With Honda's new system, the wheels steer parallel to one another in mild turns. In sharp turns the rear wheels actually steer opposite the fronts.

## All Together Now

Here are some examples of driving conditions where driver inputs are small and the wheels, front and rear, steer parallel to one another:

- Lane Changes. The next time a car passes you at freeway speeds, note how little the front wheels move to change the car's direction at high speed.
- Maintaining a Straight Course at High Speeds. Since small steering inputs are required to change lanes at freeway speeds, even less steering correction is required to keep the vehicle straight under most conditions. A crosswind or a change in road pitch would be good examples.
- Approaching a Gentle Curve. An off-ramp is a good example of a gradual direction change at high speed. Again, the wheels move very little to change vehicle course at this speed.
- Changing Direction on Uneven or Slippery Surfaces. In our younger days we all liked to "spin out" in a snowy, abandoned parking lot. Body roll or yaw is the tendency of the car to resist the change of direction. The rear of the car still wants to go straight even though the front of the car is turning. However, when all four wheels steer, side-slip is reduced.

Admittedly, traction is a real plus here. Once you begin really slipping and sliding, even the advantages of this system are lost.

## Sharp Turns—Close Quarters

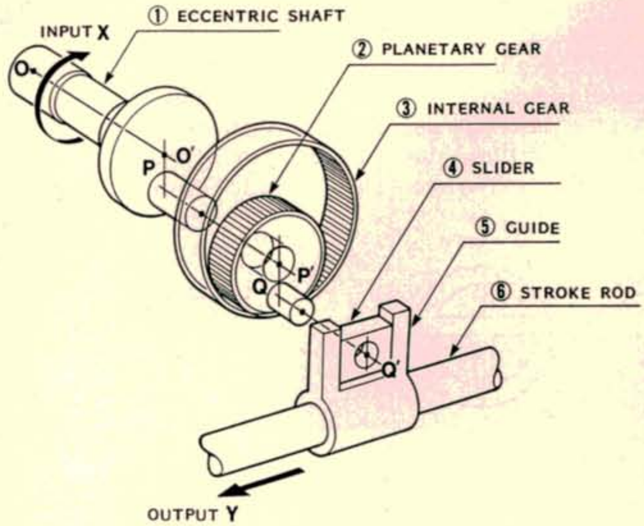
We've talked about gradual changes of direction. But what about those times when you really have to crank that steering wheel hard. In these cases, the Honda system has the front and rear wheels steer opposite one another. That's right, in a hard right turn, the front wheels steer right and the rear wheels steer left. Examples:

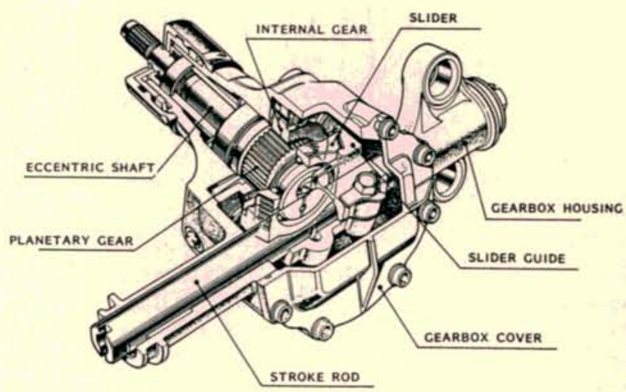
- Parallel Parking. The driver cuts the wheel hard. Steering inputs are great. By having front and rear wheels steer opposite one another, vehicle steering is magnified. The turn takes less forward movement of the vehicle. The result is a smaller turning radius.
- A Sharp Right or Left Turn. A turn at an intersection is a good example. The vehicle is making a 90-degree change of direction. However, since turning radius is reduced, less effort is required to make the turn.
- A U-turn. This is the classic example of the advantages of a reduced turning radius.

## How's It Work?

We include diagrams to show just how this system works. It really is fairly straightforward. We'll start with the engineering diagrams sent to us by Honda. We'll add some explanatory diagrams of our own to clarify things.

These diagrams are two different ways of looking at the same thing, namely the rear steering box. The




first is a schematic view. It is hardly drawn to scale, but it makes the relationship of the moving parts easier to visualize.

The second is a blueprint cutaway showing specific parts drawn to scale. It may help to compare the two drawings as we discuss the workings of the steering box.

The schematic shows the input shaft and rotation of the eccentric gear. Note that the eccentric has a drive pin on it. As the eccentric turns, the drive pin rotates the planetary gear.

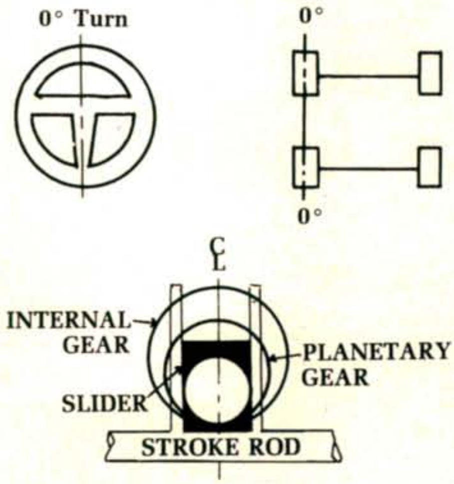
Since the planetary gear turns inside the fixed internal gear, it too rotates. The planetary gear has its own offset pin that goes through a slider which is free to move up and down in a guide. The guide is hooked to the stroke rod. The stroke rod is hooked to the rear wheels by tie rods.

## Time Out

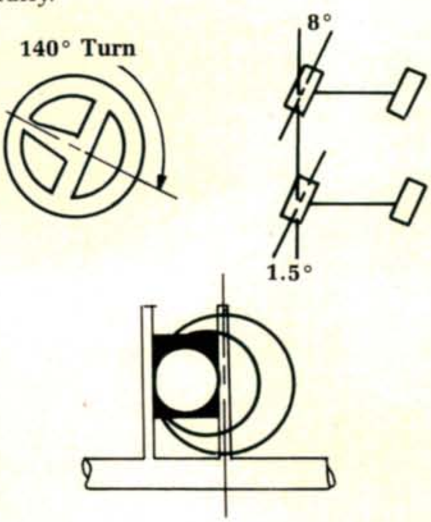
I realize that that was quite a mouthful. You may want to reread that last section again. I know I had to.

In the meantime, we'd like to add some additional schematics which may help a bit. The top left picture shows steering wheel position. The top right shows the response of the steer wheels at these steering wheel positions. The lower figure is a side view of the steering box.

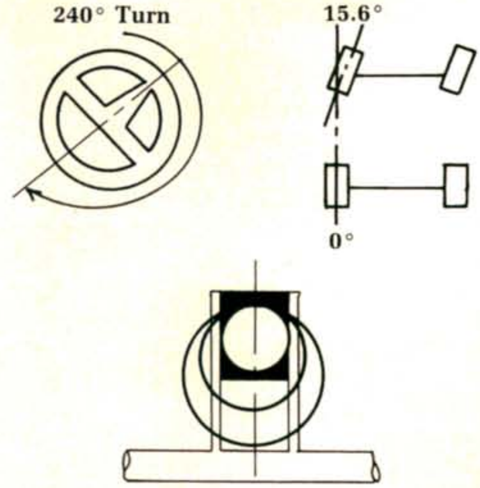
1) Straight Ahead. In this position the steering wheel is centered. The tires point straight ahead. Note that the planetary gear is centered in the internal gear. As a result, the slider drive pin is at the 6 o'clock position. The rear wheels steer straight, with the fronts.



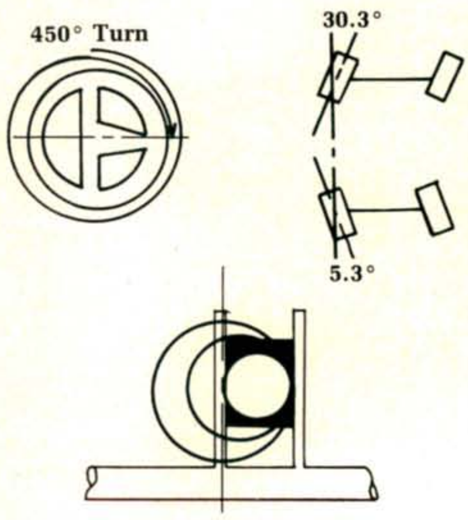

2) Gradual Turn. At less than half a turn of the steering wheel we see the rear wheels steering with the fronts. In the side view of the steering box, note that the rotation of the planetary gear has caused the slider pin to move to the 9 o'clock position. This has caused the slider to move to the side, moving the stroke rod laterally.




3) Slightly Harder Turn. About two-thirds of a turn on the steering wheel rotates the slider pin to the 12 o'clock position. Note that even though the front wheels are still turning, the rear wheels are centered again.




4) A Really Hard Turn. We've turned the steering more than one complete revolution at this point. Note that the slider pin is now at the 3 o'clock position. This puts it to the right of the center line and reverses the movement of the stroke rod. As you can see, the rear wheels are steering opposite the fronts at this point.




Remember that all of this happened gradually as the steering wheel was turned, even though we chose to highlight only four positions.

Turning the steering wheel back will reverse the changes we've shown here until we get back to straight ahead steering. Turn the wheel even farther and the whole process starts in the opposite direction.

## Whew!

That's about it. Even though the system seems a little murky at first, it's really not complicated. Hope the descriptions and diagrams helped. ■