# Steering Systems
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Definition: The device, which turns the rudders thus, causing the vessel to change course.

Here we go. The first topic and right out of the gate there is no 'best way'. I have chosen four systems that we'll take a look at in this issue. Two of these are hydraulic and two are mechanical.

The first is a manual hydraulic system. This system is comprised of a pump, which is located in the pilothouse. Attached to the pump shaft is the pilot wheel. Two hydraulic lines connect the pump to an actuator, which is located at, or near the rudderposts. The actuator then, is connected to the rudders. This actuator can be either a cylinder, which produces a straight-line motion, or a geared unit, which produces a curved motion via a crank-arm. Turning the pilot wheel in one direction causes fluid to be forced through a line to one side of the actuator while fluid is returned from the other side of the actuator to the pump through the other line. Reversing the direction of wheel turn reverses the direction of fluid flow.

This system produces a smooth and easy way to turn even moderately large rudders. Also, since the hydraulic lines can be routed via many locations, the system is excellent for triple decked boats. On the negative side, the components are a little 'pricey' when compared to most mechanical systems. Also, the motion is so smooth that you can't 'feel' the rudders. Consequently, if a rudder gets jammed, you may not realize it in time to prevent damage.

The second hydraulic system is the 'powered' system. This consists of a pump turned or powered usually from the main drive engine. It is connected to either of the above-described actuators by two hydraulic lines, which are routed through a directional control valve. This valve controls the direction of fluid flow and consequently the rudder movement. The valve is actuated either by a steering shaft running back through the vessel and turned by a wheel in the pilothouse, much like the power steering on a car. Or, the valve can also be controlled electrically by a 'joystick' in the pilothouse.

This system, when properly done, is an excellent steering system. However, it is rather complex and costly and has even less 'feel' of the rudders than the manual system. As a result, it is usually used only on large vessels with rudders of such size as to necessitate a powered system to control them.

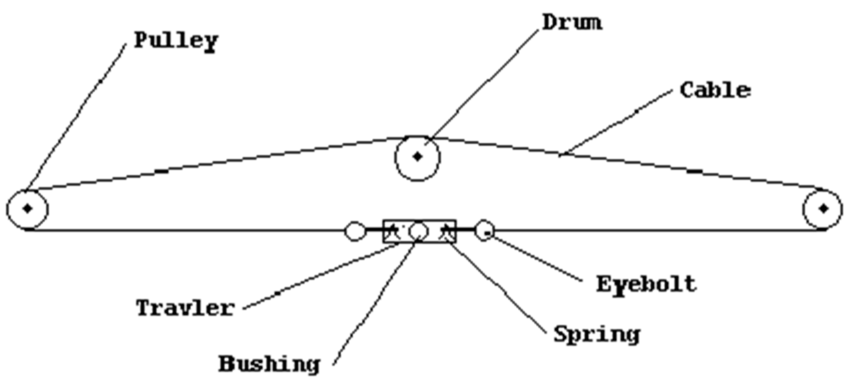
Next, we'll look at a popular and often used mechanical system. This system consists of a worm-gear gearbox, or a steering sector gearbox, usually taken from a heavy truck, and mounted at or near the rudderposts. There is also a shaft which runs fore-to-aft in the vessel and which is connected to and is turned by the pilot wheel. This shaft also connects to the input of the gearbox. Mounted to the output shaft of the gearbox is a crank-arm, which connects to the rudders. If this sounds just like the steering in your pickup truck, that's not surprising because there isn't much difference.

This is a good, simple and inexpensive system, however, a word of caution. There must be no 'play' or lost motion in the steering system on a boat! If there is play in the system, when you go to 'neutral' or centered rudder, this play will allow the rudders to drift side-to-side off center and the boat will travel like a snake even though you haven't moved the pilot wheel. Therefore, I suggest that you don't use an old, worn-out gearbox or you'll have your hands full trying to keep your boat between the banks. Been there, done that.

Now, to the mechanical steering system that I like best. It'll control vessels up to 65 or 70 feet in hull length and if you're clever will also work on triple-deckers too. It's simple, inexpensive, and easy to build and maintain. It has the added advantage of applying more force to the rudders when they are 'hard down' or full over, where you may need it, than in the neutral position where you don't need it. Yet, this system will still give you a good feel of the rudders at all times.

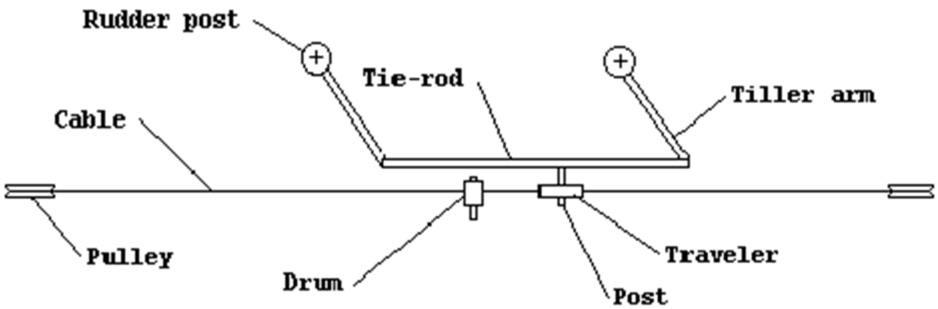
Say what? Well, since I haven't discussed rudders yet, perhaps I should explain the above statement. First, properly designed rudders are 'un-balanced' (please don't confuse this condition with the state of the writer). That is, they have more surface area behind their pivot point than in front of it. This is done to improve control of the rudders and we'll talk more about this another time. However, due to this imbalance, when the rudders are turned full over or hard down and the boat is moving ahead, the rudders want to come back to center. Also, when hard down and backing, the rudders want to stay in the full-over position. Therefore, a steering system which will apply more force in the hard-down position yet still allow a good feel of the rudders in all positions is, in my opinion, a desirable system.

Now, how does this work? First, it requires a shaft located in or just below the ceiling of the main cabin. This shaft should run from a point just under the pilothouse and is connected to the pilot wheel shaft by means of chain and sprockets. The other end of the shaft should terminate 3 to 4 feet forward of the rudderposts. At this point, it connects to a drum of 5 to 6 inches in diameter and 8 to 10 inches long. So, when you turn the pilot wheel, you are turning the drum. Located at each side of the engine room at the ceiling and in line with the drum, are two pulleys (one each side). These pulleys should be 4 to 6 inches in diameter and have a deep groove. Steel cable 3/16 or 1/4 inch in diameter is wrapped around the drum 4 to 5 times (wraps) then the free ends go out and over the pulleys and back to the center of the engine room. The ends of the cable attach to a 'traveler' via clamps, eyebolts and springs. The eyebolts should have forged eyes and the springs should be Chevrolet valve springs or equivalent (Ford works okay too). Now, when the drum is turned, this traveler moves in a straight line from side to side on the ceiling of the engine room. Located in the traveler and pointing fore-to-aft is a bronze bushing with an internal diameter of 1 1/4 to 1 1/2 inch.




RUDDERS CENTERED

The main rudderposts must extend up to the height of the traveler. Their 'tiller-arms' project forward and terminate just behind the traveler. A 'tie-rod' connects the tiller arms together and passes in line with and directly behind the traveler. A round solid steel post matching the internal diameter of the bushing is welded to the center of the tie-rod and projects forward through the bushing in the traveler. This post must project through the bushing 8 to 10 inches. Now, when you turn the drum, the traveler pulls the post thus the tie-rod, from side to side causing the rudders to turn. Since the tiller-arms travel in an arc, the tie-rod moves away from the traveler as the rudders are moved off center. This motion pulls the steel post back through the bushing and, effectively increases the length of the tiller-arms by several inches at the full over position. The result is more leverage to control the rudders when they encounter their greatest forces.




RUDDERS FULL OVER

By selecting the length of the tiller-arms, the diameter of the drum and the ratio between the main steering shaft and the pilot wheel shaft, you can establish how many turns of the pilot wheel you want to turn the rudders 40 degrees either side of center. This is the recommended amount of rudder swing but I'll talk more about that at another time.

My experience with this system has demonstrated that with a 4 foot pilot wheel, 4 to 5 turns of the wheel lock-to-lock and 42 inch tiller arms, that you'll have excellent control and a good feel of a full complement of rudders.