

# Talking Points

## The Chain Drive Transmission

One of the great success stories in fire pumps and accessories is the Waterous chain drive transmission. After two decades of experience, users have confirmed the design advantages and its reliability has been proven.

Before going into the advantages of the chain drive transmission let's get some background history that leads to the chain drive now in use. In the early 1950's the standard practice was to use spur gears in pump transmissions to transmit power from one shaft to another. Because of the distance between the truck drive shaft and impeller shaft, three gears were commonly used. Also, it was necessary to offer a selection of pump transmission ratios, which meant that the idler shaft had to be put in a different location for every ratio offered. Spur gears did an adequate job; however, they had some disadvantages in that they were very noisy (high pitched scream) and prolonged operation could actually cause fatigue in an operator standing alongside the pump.

Back then, the 750 gpm pump was the most popular pump, followed by the 500 and 1000. The power requirements of those pumps were not as great as they are for today's higher capacity pumps and generally a narrow tooth width gear was sufficient to transmit the required power. However, popularity grew for capacities of 1000 and 1250 gpm, the tooth width had to be increased (thicker gear). This pattern follows as you continue to transmit more and more power.

A partial solution for these problems came with the introduction of the CM pump in 1956. The then new "M" transmission used helical gearing which is much quieter than spur gearing. Because more teeth are engaged at any given time, a similar width gear had greater power handling capabilities. Also, the crown shaved teeth ensure that the load is carried on the center of each tooth, which is the tooth's strongest point.

Even though helical gearing provides greater power transmitting capabilities, the demand for larger capacity pumps with even greater power requirements is growing. The chain drive transmission is the answer to this demand. Since the chain wraps virtually half way around the sprockets, there are a greater number of teeth sharing the load, resulting in greater power transmitting capabilities and longer life. A smooth, quiet transfer

of power is provided by the chain drive transmission, which is a significant advantage over traditional drive methods.

Another inherent advantage of the chain drive as compared to the gear drive transmission is that this arrangement is perhaps the ideal method of transmitting power between parallel shafts running at high speeds, particularly if the shaft centers are spaced well apart. There is no need for an idler gear to fill the space between the drive gear and driven gear.

The chain we selected for the chain drive transmission is the Morse Hy-VO® chain, which is no ordinary silent chain. It is a very special, high strength, chain capable of operating at high speeds. Contrary to other chain designs and the old chain drive method, the Morse Hy-VO® chain has very little stretch.

In fact, both the chain and sprockets are machined with the utmost precision, allowing assembly that results in

a predetermined, pre-load so that after break-in, proper backlash results. This is accomplished during the normal pump test break-in at the factory.

Even though the chain drive concept has been proven in other automotive applications, one just doesn't begin using it in the fire service without doing some testing first. Waterous installed two prototype chain drive transmissions on Model CM-1000 two-stage, series/parallel pumps in service in New York City. We asked the FDNY to select two companies that would give the chain cases a real workout.

They certainly did! The chain cases were installed on pumpers in service at Engine Companies 82 and 85. In March 1975, which marked one year's service, Engine Company 82 had responded to 6427 alarms and Engine Company 85 to approximately 6,000 alarms. Nearly ten years later these two vehicles continued to serve the largest fire department in the world.

When making a comparison to a relatively standard fire department that responds to approximately 300 alarms per year, and multiplying by 20 years, you come up with 6,000 alarms-only 427 alarms less than the number responded to by Engine Company 82 of the FDNY in just one year.

A cross sectional view of the chain drive transmission is shown below. This should give you a good idea of how the chain drive transmission operates.



