Current Tow Bar Operation

The Delta push crews, for as long as I can remember, and the current tow bars in use and on the market, utilize a hydraulic hand pump and cylinder in a closed hydraulic system to “pump” the wheels down on the tow bars. The tow bars differ by manufacturer and aircraft type but are all quite similar. Depending on type they average approximately 400 to 800 pounds each. One end has an eyelet type of socket that matches up with a “pintle” hitch receiver that is standard on all push tugs. The other end of the tow bar has a unique, for each airplane type, connector (“head”) that attaches the tow bar to the nose-wheel of that aircraft. Over the years there has been a lot of engineering and development on this head to make it fast to connect and disconnect to the airplane. This head has a safety feature built in that has the ability to shear or break or in various fashions release potential side-loads to the tow bar without completely disconnecting from the airplane. The steering systems on larger aircraft are hydraulically powered and this hydraulic powering is disabled during the push back operation but if the pilot mistakenly connects the hydraulic power or the bypassing of it fails the tow bar can be immediately susceptible to an action that can be unsafe to men and equipment. Usually this is done with a “shear” bolt installed in the head of the tow bar that is designed to shear before the side load gets too great. The push operation is then stopped, the reason for the hydraulic powering is found and corrected and the shear bolt is replaced and the push recommences.

Another part of the operation must be explained here. The wheels are put up or down, depending on whether they are to be used to roll the tow bar when disconnected from the airplane. Currently they are “pumped” down with a hand pump and brought up by opening a valve at the pump that allows the hydraulic fluid to return to the pump’s reservoir and they are brought up with large return springs. The whole design could be reversed and the springs could be used to bring the wheels down instead of up (and use the pump to move the wheels up) but this would only lower the wheels until they contacted the ground and there would be no way to “fine tune” the lifting of the tow bar and the it would be difficult to disconnect the tow bar with the unbalanced load.

The push operation requires four people. One drives the tug, one walks the airplane back and wears a headset that keeps him in communication with the pilot and is the person in charge of the push and two walk below the wingtips confirming clearance for the airplane as it is being pushed. The team pushes the airplane back far enough to allow the captain to turn out of the ramp area once released by the controller of the ramp area (either a Delta controller or a ground controller depending on the airport).

This is where all of the airlines have been wasting time and time is money with an airplane. While the tug is pushing the plane via the tow bar, the tow bar has to be free from the ground. But once stopped, to disconnect the airplane, the end of the tow bar nearer the airplane must have a set of wheels lowered to pick up the weight and allow the tug to pull the tow bar away from the airplane.

The current system uses a closed hydraulic system. There is a simple hydraulic pump mounted atop the tow bar that connects to a cylinder via a hydraulic line that is hand pumped to cause a set of wheels to extend and pick up the weight for that end of the tow bar. Once the wheels are pumped down and the head end of the tow bar is aligned with the nose wheel connect point of the tow bar, the weight is counter balanced, and the head can be disconnected from the nose wheel and the tug driver is given the command from the ramp person to pull away.

The time that it takes to pump the wheels down on the tow bar is inefficient. I sat in the cockpit for years and you can feel the vibrations as the ground crew member pumps the wheels down. The captain

has already started the engine, during the push so as to be ready to move under ship power when completely disconnected. The engine is running while this hand pumping goes on and we are burning fuel to wait for the ground crew member to finish pumping the wheels down. To a ground crew member, it only seems like 5 seconds and he is pumping as fast as he can but to an engine running at 600 pounds per hour, or a fleet running at 3000 times a day, this is a lot of fuel and a lot of aircraft time.

My Idea

My idea is to get the wheels down faster. This could be done in a multitude of ways but my first suggestion is to do it with a hydraulic accumulator. (Wikipedia-- A **hydraulic accumulator** is a pressure storage reservoir in which a non-compressible hydraulic fluid is held under pressure by an external source. The external source can be a spring, a raised weight, or a compressed gas. An accumulator enables a hydraulic system to cope with extremes of demand using a less powerful pump, to respond more quickly to a temporary demand, and to smooth out pulsations. It is a type of energy storage device.

The hand pump has to move a certain quantity of hydraulic fluid to move the cylinder to move the wheels down on the tow bar. This quantity of hydraulic fluid can be pumped into an accumulator, prior to the push, by the ground crew while they are waiting on the boarding process. Then when the operator needs to put the wheels down, it can be done with a simple turning of the valve on the new system and the five seconds can be saved. Turning the valve to allow the accumulator to push the fluid to the cylinder will take far less time than pumping the cylinder down. The valve has three positions. Position 1 allows the hand pump to connect to the cylinder as it always has in the past and if the accumulator is malfunctioning, was forgotten to be pre-pumped up or the operator did not understand the new system, they can immediately return the system to the original operation. Position 2 of the valve turns the system off and leaves the wheels where they are and is the position to leave the valve in before the push allowing the operator to pump up the accumulator from this position. Position 3 is the position that allows the accumulator to quickly transfer the fluid to the cylinder and quickly drop the wheels. Once the wheels are down (Position 3), the operator moves the valve back to Position 1 and “fine tunes” the action with the hand pump if necessary. Ergonomically it may be easier to have the valve Positions moved so that the operator goes Position 1 pre-pump the accumulator, Position 2 have the accumulator transfer the accumulator fluid to the down cylinder, then Position 3 hand pump is connected to the cylinder as in the old system. These Positions can easily be moved if it is decided that it may be easier to have this 1, 2, 3 type of operation. It is a simple matter of connecting the hydraulic hoses to different ports on the valve. (Drawing 1)

Some other entirely different ways to accomplish the goal of quickly getting the wheels down are listed below this that needs to be covered in the patent:

The entire valve system could also be set up with two valves. One valve is a two way port that either connects the hand pump to the cylinder or to the accumulator via a one way check valve. In the first position the operation is as always has been and in the second position the operator uses the hand pump to preload the accumulator with hydraulic fluid. The operator preloads the accumulator before the push, goes back to the original valve position, the push commences and then when he is ready to lower the wheels another on / off valve that is teed into the cylinder line is momentarily opened to transfer the fluid

from the accumulator to the cylinder. The hand pump is already connected directly to the cylinder and the fine tuning process can be instantly accomplished, saving time. . (Drawing 2)

Another easy way to accomplish this idea of quickly lowering the wheels would be to use an electric driven hydraulic pump in parallel with the hand pump. This electric pump would be battery operated and the battery would have to be charged occasionally when the tow bar was not in use. This would be more expensive to set up and require more maintenance but could be used to “go around” a too generic patent application. . (Drawing 3)

As I mentioned earlier, the entire system could be redesigned with the springs bringing the wheels down and figuring a way to fine tune their down load. . (Drawing 4)

Another way could be to mount a large arm that is used to force the cylinder open drawing fluid through a bypass valve that is parallel with the hydraulic line between the pump and cylinder. The cylinder would actually suck the fluid from the reservoir more quickly than it could be pumped and then the hand pump would be used to fine tune the load. Care must be used here to make sure that the arm would not be in the way or possibly ever hit the airplane. (Drawing 5)