



WHAT CAUSES PTO VIBRATION?

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PTO vibration is caused by the universal joints and is especially pronounced when cornering. The output velocity of a single U-joint operating at an angle fluctuates, even though the input velocity is constant. This output velocity fluctuation becomes greater as the angle of the U-joint is increased.

To eliminate the velocity fluctuation and hence the PTO vibration, two universal joints are used. The velocity fluctuation caused by the first U-joint is cancelled by the second-U-joint, only if both are operated at the same angle.

Since most tractor/implement PTO's use the two U-joint system, why may there still be PTO vibration? It is because the U-joints are not operating at the same angle.

FIGURE 1 shows a typical PTO hook-up. For the U-joints to operate at the same angle, the distance from the end of the tractor PTO shaft to the hitch point (Dimension A) should equal the distance from the hitch point to the end of the implement input shaft (Dimension B).

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Most implements, however, have a distance greater than 14 inches from the hitch point to the end of the implement input shaft. This design is necessary to allow sufficient telescoping action of the PTO shaft, so the shaft does not bottom out on sharp turns and does not allow the two parts of the PTO shaft to separate when the PTO is in line with the drawbar.

This geometry however, does not allow the U-joints to operate at equal angles, when cornering.

Many implement manufacturers are supplying a tractor hitch extension with their implements. This extension increases the

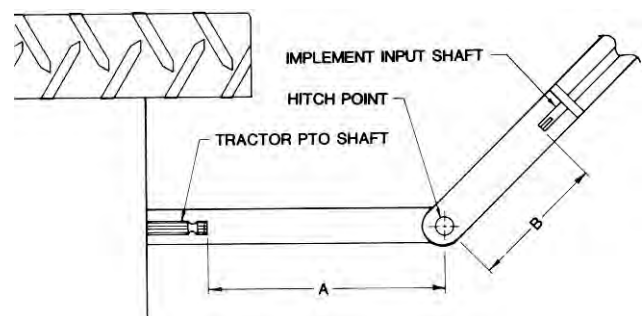


FIGURE 1.

distance from the end of the tractor PTO shaft to the hitch point. The implement and PTO shaft are designed around this new geometry so the U-joints will operate at equal angles. This geometry is commonly called the EQUAL ANGLE HITCH. Existing equipment can be modified to obtain an equal angle hitch.

A tractor hitch extension can be fabricated to increase the distance from the end of the tractor PTO shaft to the hitch point. The implement hitch will have to be shortened an equal amount. This allows the overall length of the PTO shaft to remain the same.

For example, a 540 rpm PTO driven machine is hitched to a tractor as shown in FIGURE 2A. The distance from the end of the tractor PTO shaft to the hitch point is the standard 14 inches. The distance from the hitch point to the input shaft of the machine is measured and found to be 20 inches, making the overall distance

34 inches (14 and 20). For the PTO to operate at equal angles the hitch point should be 17 inches (34 divided by 2) from both the end of the tractor PTO and the input shaft of the machine.

As shown in FIGURE 2B, a 3 inch extension is bolted to the tractor drawbar and the machine hitch is shortened 3 inches. It should be noted the overall distance of 34 inches has not changed and the original PTO shaft can still be used.

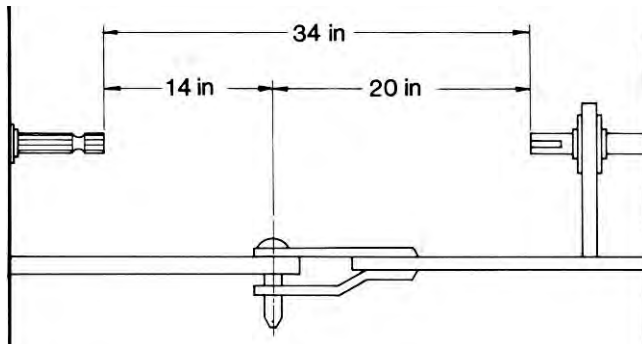


FIGURE 2A.

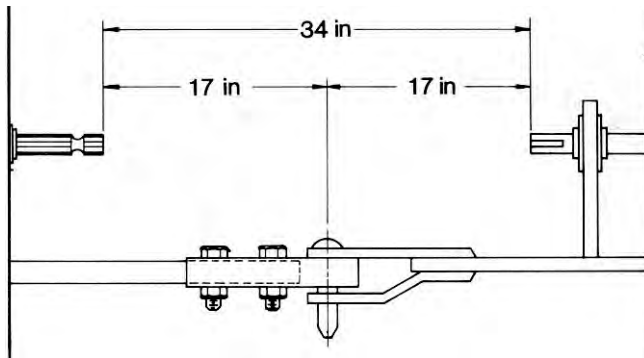


FIGURE 2B.

However, the machine cannot be operated unless the drawbar extension is bolted to the tractor drawbar.

Most tractors with 1000 rpm (1-3/8" diameter) PTO shaft have a distance of 16 inches from the end of the tractor PTO shaft to the hitch point. The same procedure can be used as in the example, however, the dimensions will be different.

These modifications should not be undertaken unless the person doing the modifications is completely familiar with the above procedure.

It is also important to phase the U-joints correctly. The correct and incorrect phasing of U-joints is shown in FIGURE 3. Proper phasing of the U-joints allows the velocity fluctuation caused by the first U-joint to be cancelled by the second. Improper phasing compounds the velocity fluctuations and will cause severe vibration.

The two parts of many PTO shafts are designed to fit together only the correct way. This eliminates phasing problems.

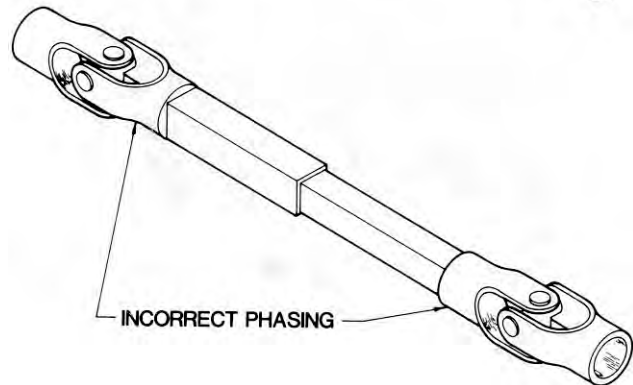
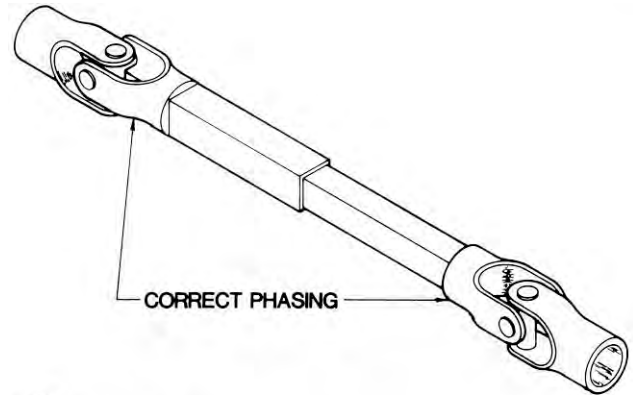


FIGURE 3.

The design of a tractor/implement PTO with three U-joints is more complicated than a two joint system. The third U-joint in the drive line is usually located at a gear box or sheave on the machine. If this U-joint operates at an angle of only a few degrees, it is only necessary to ensure that the U-joints at the hitch are properly phased and operate at equal angles.

However, if the third U-joint operates at an angle it may be impossible to eliminate PTO vibration even if the U-joint at the hitch are phased and operating at equal angles.



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