Abanico Agroforestal. January-December 2021; 3:1-7. http://dx.doi.org/10.37114/abaagrof/2021.5
Technological Development. Received: 10/02/2021. Accepted: 17/07/2021. Published: 12/08/2021. Code: e2021-11

Truck coupling as a power take-off for fixed agricultural equipment

Cople de camioneta como toma de fuerza para equipos fijos agropecuarios

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ABSTRACT

The expression power take-off (PTO) is used to indicate the rod or rods that transmit the mechanical power of a machine. It is an axial rod fluted at one end and driven by a motor. In the present work, the power take-off of a light truck is proposed as an accessory for stationary farm equipment. This power take-off consists of a base, and the rod or rods that transmit the mechanical power. At the base of the rods is a round plate that is screwed directly onto the back axis of the vehicle. The proposal is to install this accessory on vehicles at the factory, at an approximated cost of US$50.00 (MX$1000.00). With this accessory the farmer can power fixed farming equipment like fodder mills, food mixers and choppers. This design is an economical and functional way to connect the power take-off of the light truck to stationary farm equipment.

Keywords: foods, machinery, technology, power take-off.

RESUMEN

La expresión toma de fuerza significa la flecha o flechas que transmiten la potencia al mecanismo de la máquina. Es un eje estriado en un extremo, accionado por un motor. En el presente trabajo se propone un accesorio como toma de fuerza de camioneta para equipos fijos agropecuarios. Esta toma de fuerza consta de una base y una flecha. En la base de dicha flecha tiene una placa redonda que es atornillada directamente a la flecha derecha del eje trasero del vehículo. La propuesta es que los vehículos al fabricarse cuenten con dicho accesorio y tendría un costo aproximado de US$50.00 (MX$1000.00). Con este accesorio el empresario agropecuario moverá equipos agropecuarios fijos como molinos forrajeros, mezcladoras de alimento y picadoras. Este diseño conecta la flecha lateral de la camioneta a un equipo fijo agropecuario, de una manera económica y funcional.

Palabras claves: alimentos, maquinaria, tecnología, toma de fuerza.

INTRODUCTION

In agriculture and livestock as in any industry, most of the equipment works with a shaft that rotates on its own axis; this shaft is coupled to the power take-off of tractors or stationary engines specially designed for that purpose. Currently, there are several PTO designs for high and low revolutions per minute, which can be gasoline, diesel (agricultural tractors and stationary engines) and electric engines. However, these special equipment are expensive and unaffordable for the agricultural producer in our countryside, which normally lacks electric current. It is known that the agricultural and livestock producer needs equipment that requires power, for example, for water pumps, power generators, forage mills and choppers, feed mixers, feed conveyors, among others. Taking into account the above, an alternative solution to the problem of acquiring PTO engines is the PTO of a pickup truck for fixed agricultural equipment, since most producers have a pickup truck with either 4, 6 or 8 cylinders, which also has the advantage of working with low and high revolutions per minute.

The databases of the National Patent Bank of the Mexican Institute of Industrial Property were consulted and no record was found in the databases, applications and industrial designs related to the pickup truck power take-off for fixed agricultural equipment; therefore, the process for patent registration has been initiated (Correa and Bergel, 1996; González, 2007).

In early years of American Union, farmers used hand tools such as sickles and scythes to harvest grain. Slow oxen pulled their plow. Later, and for more than a century, they used horses and mules to pull their farm implements. The population was growing in the cities of the United States, requiring more production from the fields for their own consumption and for export to countries that wanted to buy. The new fields and farms were larger; they could not be worked to their full capacity with the small implements and animal power. More and better motive power was needed (Hunt, 1991).

In about 1850, some larger machines such as the harvester and grain threshing machine began to be used, driven by a connecting rod on the axle of the equipment that was pulled by animals (Johnson *et al*. 1998; Arnal & Laguna, 2000). Animal-drawn sprinklers and harvester were also designed, which are driven by a connecting rod and shaft crank system, with a gearbox that provides a rotational multiplication of 1 to 27 (López *et al*. 1982a; López *et al*. 1982b). From the connecting rod system and the gearbox, the pickup truck power take-off project for fixed agricultural and livestock equipment starts. The objective of the present technological development is with the purpose that the producers or agricultural entrepreneurs with low economic resources, can make use of fixed agricultural equipment that require power take-off, without requiring the agricultural tractor or electric motors.

MATERIAL AND METHODS

The accessory consists of a rigid steel coupling 4.5 inches long and 1.6 inches in diameter (see figure 1), which installed in series would cost approximately US$50.00 (MX$1000.00). The coupling, like the tractor's PTO, has a standard groove for agricultural shaft extensions and a safety groove for a bolt to prevent the shaft extension from slipping off. The base of the PTO coupling consists of a round plate that is bolted directly to the right rear axle shaft of the vehicle. Another model of PTO may be bolted to the drum lug bolts that attach to the tire (Vaughn, 1988). It is necessary to lift the right rear tires and ensure that there is no movement in the remaining tires. Once the forage equipment is coupled to the power take-off (coupling) by means of the shaft extension, the truck is turned on and it is decided whether to work at low or high revolutions according to the agricultural equipment to be used, then the truck's gearbox is placed in the appropriate position and the accelerator is set to the rpm indicated by the manufacturer of the equipment in question. This PTO has the advantage of having different speeds, including reverse, which is advantageous for unclogging some equipment.

RESULTS AND DISCUSSION

A mechanism is a mechanical device that has the purpose of transferring motion and/or force from a source to an output (Erdman & Sander, 1998). The term coupling refers to a device that is used to join two shafts at their ends for the purpose of transmitting power. There are two general types of couplings, rigid and flexible. Rigid couplings are designed to join two shafts tightly together so that no movement is possible between them (Mott, 1995). The proposal is that vehicles should have such an accessory when manufactured. The tractor power take-off is a shaft, splined at its end, driven by the engine and intended to move certain types of machines coupled to the tractor (Arnal and Laguna, 2000).

When the shaft is seen from the rear of the tractor, the rotation of the tractor power take-off is clockwise, so it is necessary that the power take-off of the truck be of the right shaft of the differential, since, if it is connected the equipment to the left shaft of the differential, the latter will rotate to the left side (Hunt, 1991; Halley, 1990). Figure 2 shows fixed agricultural equipment connected to the truck's power take-off. It is also possible to connect dynamo equipment to generate electric current, horizontal or vertical mixers, as well as water pumps among other industrial equipment, as long as they are fixed (Ortiz-Canavate, 1995).

Figure 1. Coupling as power take-off

Figure 2. Fixed agricultural equipment connected to the truck's power take-off

The tractor power take-off has the mission to give movement and power to the internal mechanisms of some machines, provided that these machines are conditioned to receive movements and power. The expression "power take-off" means the shaft or shafts of the tractor that transmit power to the accompanying machine mechanism (Liljedahl *et al*. 1984). The power take-off can be used either with the tractor stationary or in motion and, in the latter case, the engine power is distributed between the machine drive and the movement of the tractor-machine assembly and on the ground. The dimensions of the external PTO connection element are internationally standardized, with fixed length, diameter and spline size, so that manufacturers of PTO-driven machines adapt to these dimensions and any machine can be coupled to any tractor (Arnal & Laguna, 2000). The normal speed of the PTO shaft is approximately 536 rpm, although a second shaft with 1000 rpm already exists (Hunt, 1991).

Both in the pickup truck and in the tractor, the power take-off has a connection system that is carried out by means of a clutch consisting of a sliding collar that, depending on its position, makes or interrupts this movement (Arnal & Laguna, 2000). The 4-, 6- and 8-cylinder trucks are capable of working at low and high revolutions per minute, with the same amount of rpm or more than the tractor's power take-off. Some trucks have a tachometer that indicates the rpm, according to the acceleration of the engine. When a truck does not have a tachometer, it is necessary to measure the perimeter of the tire (P) and according to the mileage per hour (km/h) and divided by 60 minutes we obtain the rpm. For example, if a truck has tires with a perimeter of 1 meter, when accelerating it at 40 km/h, it will travel 40 000 meters in one hour, that is 40 000 revolutions per hour, and these divided by 60 minutes, it results that the lateral arrow of the differential of the truck is turning at 666 rpm.

Tractor engine power, unlike that of trucks and cars, is used for different objects. However, tractors are not the right units for many family-sized livestock enterprises (Lopez *et al*. 1996). In addition, the agricultural tractor is very slow to move, so nowadays trucks (with 4, 8-cylinder or larger capacity engines) are also used to generate electricity and air and to tow different agricultural equipment.

There are also vehicles with a second power pulley, others have a hydraulic system. And last but not least, Mercedes Benz has manufactured a vehicle with front PTO. These are two auxiliary circuits for driving elements such as brush cutters or sweepers with flow regulation pumps (Mercedes-Benz, 2007).

As for the performance of the gasoline engine compared to the diesel engine, no results are available yet. However, in Mexico there are a large number of fixed agricultural equipment that were supported by SAGARPA's Alliance for the Countryside Program SAGARPA's and many of them are not working due to lack of tractor or electric current.

CONCLUSION

This design connects the side shaft of the truck to a fixed agricultural equipment, in an economical and functional way, so that farmers or agricultural entrepreneurs with low economic resources, can make use of fixed agricultural equipment that require PTO, without requiring the agricultural tractor or electric motors.

ACKNOWLEDGMENTS

Thanks to the Science and Technology Council of Nayarit (COCYTEN).

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