ACADEMICIA: An International Multidisciplinary Research Journal
ISSN: 2249-7137 Vol. 11, Issue 12, December 2021 SJIF 2021 = 7.492
A peer reviewed journal

A BRIEF REVIEW ON THE THOMPSON CONSTANT-VELOCITY JOINTS IN THE 4 WHEELER

Dr. Pavankumar Singh*

*Assistant Professor,
Department of Applied Science (Physics), Faculty of Engineering,
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, INDIA
Email id: pavan.engineering@tmu.ac.in

DOI: 10.5958/2249-7137.2021.02630.6

ABSTRACT

Coupling of different driven components is needed in a direct mechanical drive system. The majority of drive elements, such as gear reducers, lead screws, and a variety of other components, are powered by a shaft supported by many bearings. A drive shaft is slightly misaligned due to the couple's stiffness. The objective of the power transmission relation is to transmit torque from the driving shaft to the tube while accounting for shaft misalignment. Unnecessary wear pressures on the shaft bearings may be caused by shaft misalignment. There are few conventional solutions for misalignment issues, such as Oldham's coupling and universal joints, which have many disadvantages. Thompson's constant velocity (CV) coupling addresses these issues by reducing side loads, increasing misalignment, increasing running speeds, improving transmission performance, and more. The nature of constant velocity joints is investigated in this article, as well as their optimization. Many academics' research on transmission relations and constant speed joints is summarized in this article.

KEYWORDS: *Coupling, Power, Thompson Constant, Transmission, Velocity joint.*

1. INTRODUCTION

The fundamental function of a power transmission link is to transmit torque from an input/driving shaft to an output/driven shaft at a specified shaft speed, including shaft misalignment. Shaft misalignment is a sign of a variety of issues, including installation flaws and resistance variations. Misalignment will be exacerbated by the axial and radial forces acting on the relationship. In misaligned shaft applications, the coupling often introduces unwanted side loads. Flexing or compressing cup components, dynamic coupling action, frictional loading, and charges all cause side cargos[1].

Constant-velocity joints (also known as homo-kinetic or CV joints) allow a drive shaft to transmit power through a variable angle, at constant rotational speed, without an appreciable increase in friction or play. They are mainly used in front wheel drive vehicles. Modern rear wheel drive cars with independent rear suspension typically use CV joints at the ends of the rear axle half shafts and increasingly use them on the drive shaft. Constant-velocity joints are protected by a rubber boot, a "CV gaiter", usually filled with molybdenum disulfide grease. The six spheres are bounded by an anti-fall gate that prevents the spheres from falling when the shafting's are perfectly aligned. Cracks and splits in the boot will allow contaminants in, which would cause the joint to wear quickly as grease leaks out. (Parts in contact would not get proper lubrication, small particulates would cause damage and scratching, while water ingress causes metal components to rust and corrode.) Wear of the boot often takes the form of small cracks, which appear closer to the wheel, because the wheel produces most of the vibration and up and down motions[2]. Cracks and tears in the areas closer to the axle are usually caused by external factors, such as packed snow, stones or uneven rocky off-road paths. Aging and chemical damage can also cause boot failure.

The universal joint, one of the earliest means of transmitting power between two angled shafts, was invented by Gerolamo Cardano in the 16th century. The fact that it failed to maintain constant velocity during rotation was recognized by Robert Hooke in the 17th century, who proposed the first constant velocity joint, consisting of two Cardan joints offset by 90 degrees, so as to cancel out the velocity variations. This is the "double Cardan". Many different types of constant-velocity joints have been invented since then.

Early front wheel drive systems such as those used on the 1930s Citroën Traction Avant and the front axles of Land Rover and similar four-wheel drive vehicles used universal joints, where a cross-shaped metal pivot sits between two forked carriers. These are not CV joints as, except for specific configurations, they result in a variation of the angular velocity. They are simple to make and can be tremendously strong and are still used to provide a flexible coupling in some prop shafts, where there is not very much movement[3]. However, they become "notchy" and difficult to turn when operated at extreme angles.

The Thompson constant velocity joint (TCVJ), also known as a Thompson coupling, assembles two cardan joints within each other to eliminate the intermediate shaft. A control yoke is added to keep the input and output shafts aligned. The control yoke uses a spherical pantograph scissor mechanism to bisect the angle between the input and output shafts and to maintain the joints at a relative phase angle of zero. The alignment ensures constant angular velocity at all joint angles. Eliminating the intermediate shaft and keeping the input shafts aligned in the homo-kinetic plane greatly reduces the induced shear stresses and vibration inherent in double cardan shafts[4].

While the geometric configuration does not maintain constant velocity for the control yoke that aligns the cardan joints, the control yoke has minimal inertia and generates little vibration. Continuous use of a standard Thompson coupling at a straight-through, zero-degree angle will cause excessive wear and damage to the joint; a minimum offset of 2 degrees between the input and output shafts is needed to reduce control yoke wear. Modifying the input and output yokes so that they are not precisely normal to their respective shafts can alter or eliminate the "disallowed" angles.The novel feature of the coupling is the method for geometrically constraining the pair of cardan joints within the assembly by using, for example, a spherical four bar scissors linkage (spherical pantograph) and it is the first coupling to have this combination of properties.

The Thompson connection is the world's first and only constant velocity joint:

- All roller bearing loads are present.
- There should be no sliding or skipping surfaces.
- Can withstand axial and radial loads degradation

- There is no torque cap, and every torque stage is designed.
- There is no need for any further lubrication.
- You won't have to clean up the dust.
- Except for replaced rollers and rummages, no components wear.
- Can be used to attach a vehicle tail or hose pipe.
- Is a genuine CV connection the same as a CV connection?
- It's easier to carry than a double cardan or joint.

The Thompson Coupling consists of two coaxially constructed cardan joints with cross-cutting counterparts linked together by trunnions and rollers that are forced to lie on the homocentric level of the joint at all times. A spherical four-bar connection with two segments or a spherical draglink are the limiting methods for such trunnions and coils[5]. A trunnion is attached to the input shaft at the end, and the second end of the draglink is mounted to a detachable pin that creates a trunnion on the inside of the jack of the output shaft. Each arm or bar of the jig is continuously formed by a huge circular ark centered on the axis of the joint. Figure 1 shows the drive axle.

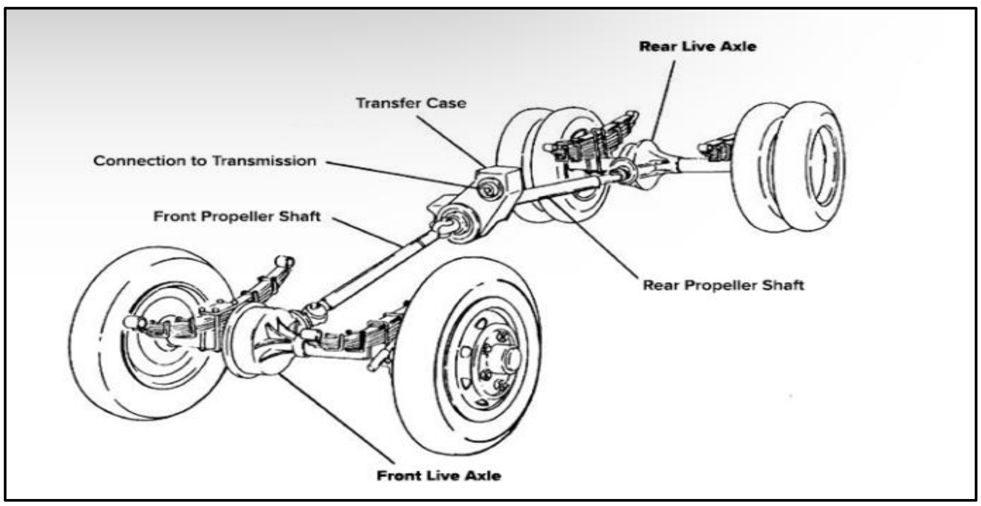

Figure 1: The drive axle.

The Draglink's central axis is located on a trunnion in the "C" member's center; the "C" member's ends are located on the extensive trunnions that connect the two Cardan joints. The included acute angle constantly splits between the enlarged inlet and outlet axes and therefore sits on the axis of the homo-kinetic joint plane due to the action of the joint, the central axis of the draglink, and thus the trunnion in the "C" component. Four bar attachment structures that are structurally sound stay spherical, as is well known. Along the three rotational axes, namely the input shaft axis, the output shaft axis, and the homo-kinetic plane axis, the coupling components stay aligned[6]. Every component of the Thompson may be mass-produced by forging and/or casting, with the drilling and machinery of the bearing magazines, trousers, and circular grooves being the sole exception. There is no specialized equipment or highly skilled craftsmanship. For the most part, bearings are readily available, and installation is straightforward.Complete power transmission connection for constant speed joints is required as vehicle engine efficiency increases.

Thompson utilized a constant velocity joint. The Thompson CV connector's main features are reduced or eliminated side loads, shaft failure, and improved drive accuracy. The Thompson Constant Speed Joint is the most efficient way to transmit power between the two. Shafts with an angle of 30 to 65 degrees were the only portions with parasite bearing joints. No Swinging loads are transferred to the output shaft thanks to the constant Thompson speed joint. Figure 2 shows the constant velocity joints in 4-wheelers.

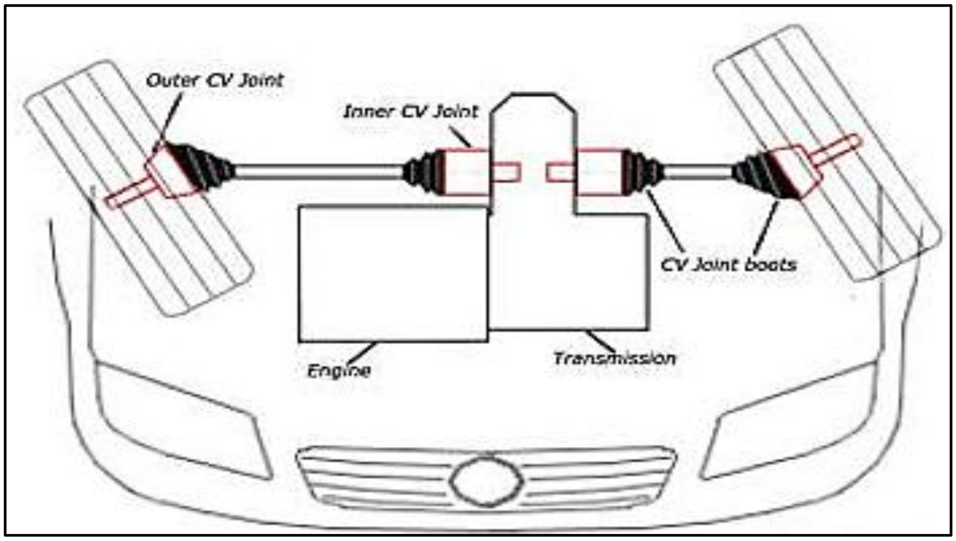

Figure 2: Constant Velocity joints in 4-wheelers.

Constant Velocity joints, or CV joints, are found on both ends of the drive shafts (half shafts) in both front-wheel drive automobiles (half shafts)[7]. The gearbox is connected to the drive shafts via an internal CV, and the drive shafts are connected to the wheels by an exterior CV. CV joints are also available for some rear-wheel-drive and four-wheel-drive vehicles, as well as lorries (figure 1). When adjusting the suspension's up and down movement, the CV joints are needed to ensure that torque is transferred continuously from the driving wheels. During twists with the front wheels, CV joints give torque to the front wheels. There are two kinds of CV joints that are often used: one is a ball, and the other is a tripod. Ball-type CV joints are utilized on the outside of the drive shafts (outer CV joints), whereas tripod-type CV joints are used more on the interior of the drive shafts (inner CV joints).

1.1 Benefits:

- Friction, heat, wear, collateral damage, and vibration are all reduced.
- Full load operating at high shaft output angles indefinitely
- Reduced energy loss
- Allows for greater output angles to the shaft in contemporary designs.
- Can be played at room temperature for a long time.

Working at 20° angles with customized frames up to 45°, this is a true constant-speed joint with no sliding surfaces at load bearing. The Thompson Constant Velocity Link (TCVJ) transfers a drive via an angled junction of driving and driven shafts in a one-to-one connection. Over misaligned shafts, a constant Thompson speed joint is utilized to address the limitations of conventional transmission systems. Aside from the Thompson constant speed joint, there are additional constant speed joints [8].

3. DISCUSSION

Working at 20° angles with customized frames up to 45°, this is a true constant-speed joint with no sliding surfaces at load bearing. With a genuine one-to-one connection between the shafts, the Thompson Constant Velocity Link (TCVJ) transfers a drive via an angled junction of driving and driven shafts. The TCVJ has addressed and solved the traditional universal joint issues of driving power along a curve of heat, friction, power loss, and shaft speeds. The TCVJ, with its associated sliding shaft operating at near ambient temperatures and with no inherent vibrational effects in its design, actually reduces vibrational inputs from gears, reduction units, and motors, extending the machine's life. The TCVJ arose from a new understanding of the vectors in spinning shafts and the need for directional changes without the use of weight-bearing sliding components[9].

The Thompson Coupling is made up of two coaxially built cardan joints with cross-cutting equivalents that are connected together by trunnions and rollers that are always compelled to lay on the joint's homocentric level. The limiting techniques for such trunnions and coils are a spherical four-bar connection with two segments or a spherical draglink. The input shaft is terminated with a trunnion, and the second end of the draglink is connected to a detachable pin that forms a trunnion on the inside of the output shaft's jack. A massive circular ark centered on the axis of the joint continually forms each arm or bar of the jig. The central axis of the Draglink is situated on a trunnion in the middle of the "C" member, and the ends of the "C" member are located on the large trunnions that connect the two Cardan joints. Due to the action of the joint, the central axis of the draglink, and therefore the trunnion in the "C" component, the included acute angle continuously divides between the expanded intake and outlet axes and so sits on the axis of the homo-kinetic joint plane. As is widely known, four bar attachment systems that are structurally sound remain spherical. The coupling components remain aligned along the three rotational axes, namely the input shaft axis, the output shaft axis, and the homo-kinetic plane axis[10].

The drilling and mechanism of the bearing magazines, trousers, and circular grooves are the only components of the Thompson that cannot be mass-produced by forging and/or casting. There are no specialized tools or highly trained craftspeople. Bearings are, for the most part, widely accessible, and installation is simple. As vehicle engine efficiency improves, complete power transmission connection for constant speed joints is needed. Thompson used a joint with a constant velocity. Reduced or eliminated side loads, shaft failure, and better drive precision are all advantages of the Thompson CV connection. The Thompson Constant Speed Joint is the most effective method of power transmission between the two. The only parts having parasite bearing joints were shafts with an angle of 30 to 65 degrees. The constant Thompson speed joint prevents swinging loads from being transmitted to the output shaft.

4. CONCLUSION

Because transmission is such an important component of any mechanical power system, its efficiency is directly proportional to its efficiency. The transmission link is the most significant factor that affects the transmission system's efficiency, therefore a comprehensive examination of the transmission connection is needed for coupling without failure. Over misaligned shafts, a constant Thompson speed joint is utilized to address the limitations of conventional transmission systems. Aside from the Thompson constant speed joint, there are additional constant speed joints. Thompson's constant velocity coupling will undoubtedly offer data for future transmission investigations. TCVJ also offers optimization recommendations for future research and use of constant velocity joints.

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