



# An Analysis of the Location of the Transmission in Tanks

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## INTRODUCTION

Tanks have served a big part in almost every war since World War I. The basic concept seems simple to us now: a box of armor that protects the people inside from external harmful weapons. Da Vinci designed a quite famous tank, and the son of famous Russian scientist Mendeleev created a design for an 170 ton monstrosity that would run off of a 1000hp submarine engine and featured front armor and a gun as big as bleeding edge tanks in 1944(Milson, 1971, 11). Much research has been done on the history of tank design over time, but one element remains a mystery to us not making the decisions. During and before WWII most nations chose to have the transmission in the front. However, some nations like the British decided to have the transmission in the rear as a rule of thumb, and the entire thing seems to be cloaked in some mystery. Some people can tell you why cars have differing front and rear wheel drive; however, that does not apply to tanks because they use a track that should apply force evenly across the entire ground. One of the main reasons appears at first to be a family tree, and although that is part of it, it is not very significant to the fast paced development, as people did switch the transmission around, with eventually all nations deciding to move it to the rear of the tank.

### What does the transmission actually do?

The transmission in a tank is very similar to that of a car and is used for changing gears. Almost all tanks ever being manual gear shift, and also changing the direction of the crankshaft. In some tanks the transmission is slightly different as it had to be able to run one track back and one track forward which allowed the tank to turn in place.



The easiest way to tell where the transmission is the location of the sprocket wheel. This is what connects the transmission to the track

Figure 1  
Location of Sprocket Wheel

## RESEARCH METHODOLOGIES

- I was first introduced to the question in tank videos where people seemed to have little idea and were just hypothesizing.
- At first I turned to looking for primary sources from original designers in documents; however, this failed as I couldn't find the documentation.
- Then I turned to find differing theories on the location of the transmission at which point I used both primary sources from memoirs and technical review of tanks from after WWII.
- Some of the best sources were by Hunnicutt, Milsom, and Fletcher.

## DATA AND FINDINGS

### Theory 1: Self Cleaning Front Transmission

A transmission in the rear would have resulted in a sprocket wheel in the rear (see figure 1); this would have been bad due to the fact that all the mud and grime would have ended up in the wheel, which would then make cleaning difficult. However, if the transmission is in the front, the theory is that the dirt and mud would be knocked off quite a bit by the time it got the wheel making it much easier to start up. However, this appears to not be really important at all, as during Operation Barbarossa, in which the Red Army was helped from the harsh Russian winter that came in 1941. This caused many losses to both sides; however, the Russians were much more prepared. This is in small part because the German tanks would get mud in the sprocket wheel during the day, which would freeze overnight. In this case, it may have been better to have the transmission in the rear, because the heat from an on engine would have melted it quicker. However, this was likely not a large factor, as it would be easy enough for soldiers to clean mud from sprocket wheels before they slept.

### Theory 2: Allowance for Differing Engines

Although I didn't find any reference to this in the documents, it is supported by the fact that the Americans threw so many different types of engines into the back of the M4 Sherman, which allowed for a lot of versatility when giving it to allies to support what engine they were producing domestically. However, this seems more like something that ended up being helpful and not something they thought of as really if you moved the transmission to the rear you could just move everything in front more forward, or elongate the tank like they did on the M4A4 to make room for the 5 strapped together engines.

### Theory 3: Drivetrain in the Fighting Compartment

The drivetrain will take up more space if it runs through the tank to the front; this is also a hazard to the crew due to the fact that an exposed drivetrain can chop someone's leg off, so you would need more space to cover the drivetrain to prevent injuries (see figure 5). This appears to not have been that big an issue with the transmission being up front because it does not appear in books about tanks with and without transmissions in the front and rear. Also little care was given to the comfort of the crew in tanks.

### Theory 4: Weak Spot or Speed of Change

This theory is that to put the transmission you would either have to have a weak spot and have it much more difficult to change the transmission or it will be much more difficult to change but you would lack a weak spot. The Tiger and Panther are good examples of a more difficult to change transmission. This is because instead of having bolts in the front plate, mechanics needed a crane to go in from the top. This was significantly different in earlier Sherman tanks where the transmission was less protective (Moran 2020). This theory however, seems unlikely as the US built a later plate that provided nearly maximum protection and could be easily opened.

### Theory 5: Balance Issue

The transmission weighs a lot, and so does the engine in a tank, so in the beginning the designers might have used the transmission to balance out the fact that the engine was in the rear. However, as the front armor increased in tanks, the transmission got put in the back as the armor would balance out the transmission. The balance if done wrong could cause the tank to be "front heavy which wore out the drive train"(Makos Spearhead 2019). This appears to be the most important theory as it makes the most sense, and explains why after WWII almost every transmission got put in the rear. It also explains why the British generally had the transmission in the rear of their infantry tanks which were heavily armored and not in the rear of the cruiser tanks which were less armored. However, it doesn't explain why some early Soviet tanks such as the T-34 had it in the rear.



Figure 2  
Front plate on Panther and early M4

See the difference between the two plates  
The Sherman's has bolts that could become projectiles in the tank, but the Panther couldn't open easily

An example of how strong the front plate of a Sherman could be even with the transmission in the front

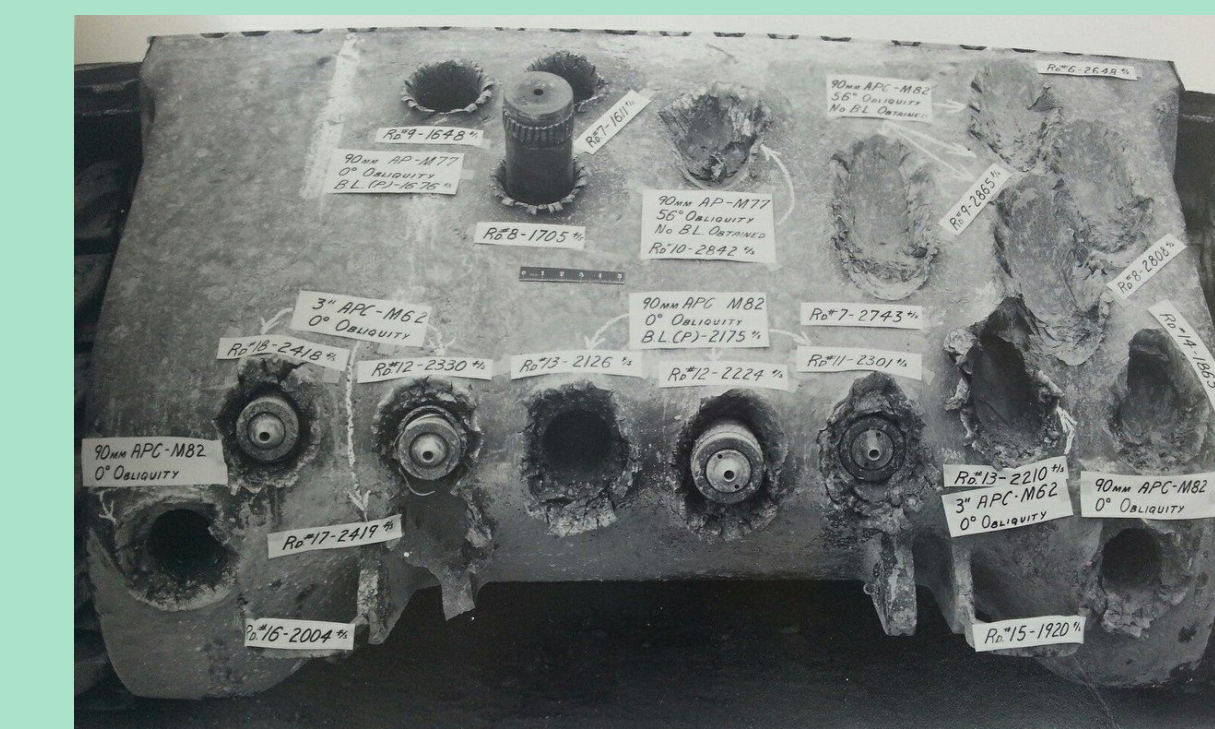


Figure 3 M4A3E2 Jumbo Sherman front plate (1944)

An example of the drivetrain raising the turret basket significantly to make sure crews weren't injured in the m4a4

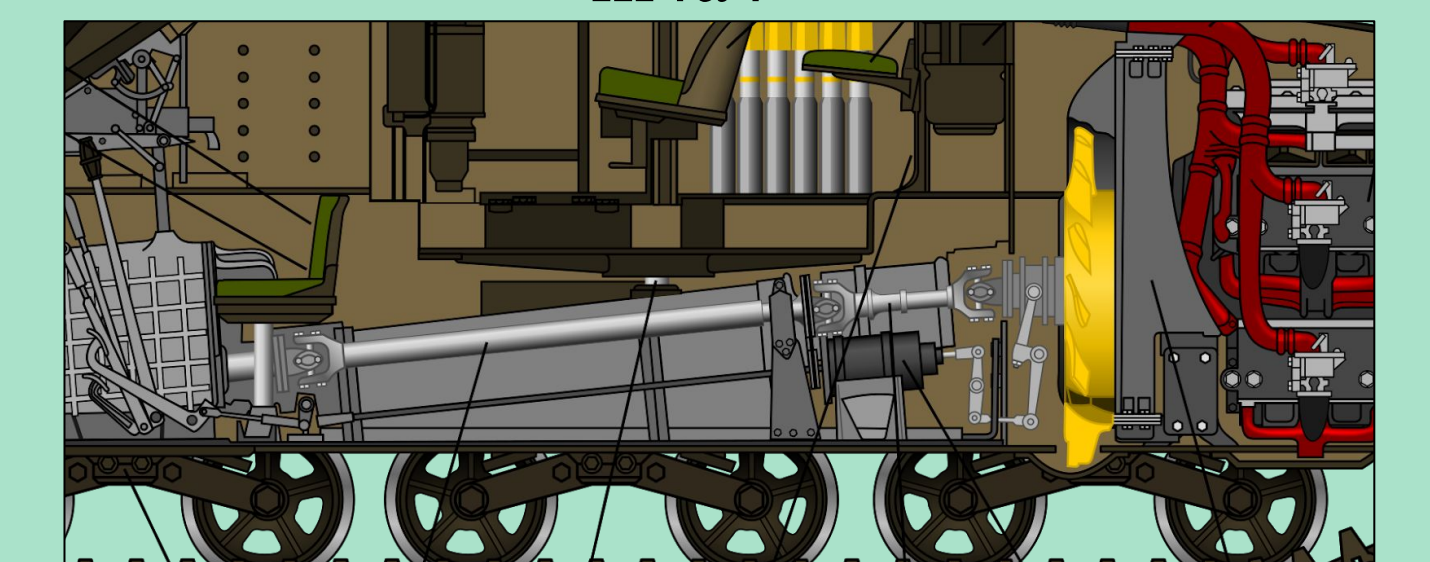


Figure 4 M4A4 Sherman Cutaway (1943)

## ACKNOWLEDGEMENTS / REFERENCES

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