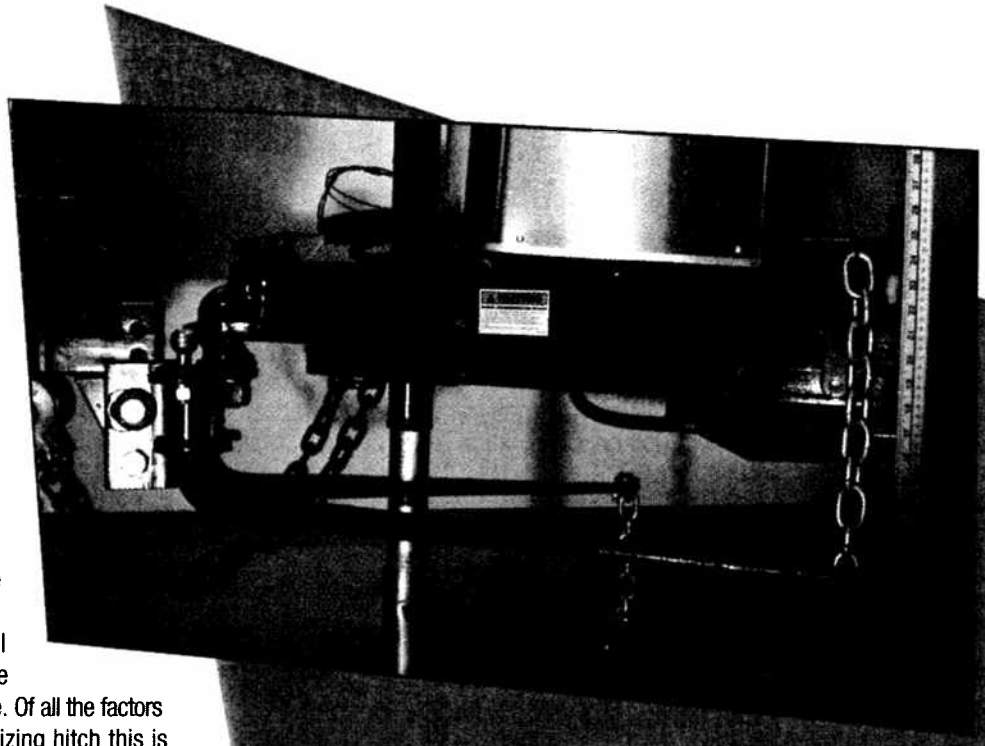
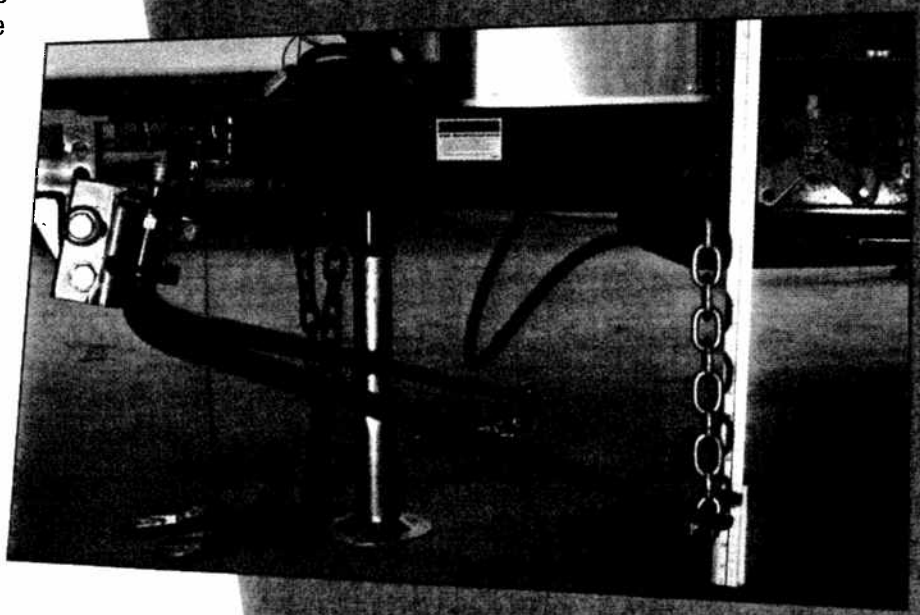
Why Is Your HITCH CROOKED?

By Andy Thomson



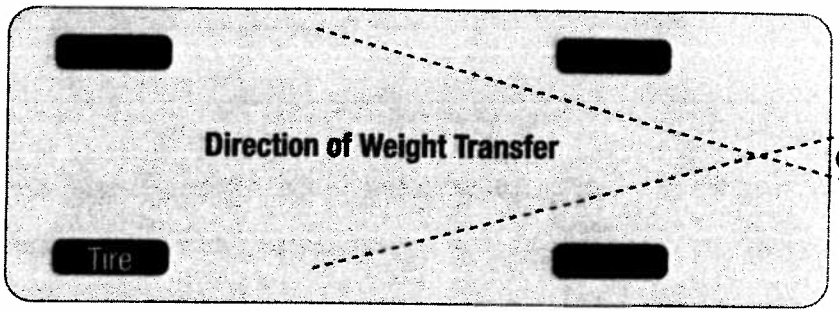
Why is your hitch crooked?" is a question that gets asked of our customers on a fairly regular basis. Most of the equalizing hitches you see have the ball mount bolted together so the ball mount is perfectly vertical or fairly close to it. We assemble ours with as much rearward angle as possible, which prompts the above question.

In the Spring 2010 issue I promised I would explain the importance of the ball mount angle. Of all the factors that go into a properly set up equalizing hitch this is likely the least understood. Though the primary job of the equalizing hitch is to transfer weight to the front wheels of the tow vehicle, *how* the weight is transferred impacts handling.

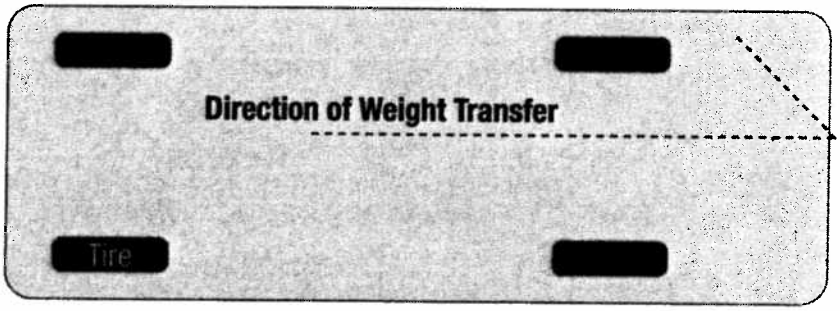


In the top photo the ball mount is bolted together square. The pivot axis of the torsion bars is perfectly vertical and it would seem that this is the right way to bolt it together—after all, it just looks "right." But it isn't. You can see in the picture that the ends of the torsion bars are 11" off the ground, before they are connected (note disconnected torsion bar on the curb side of trailer). The last link in the chain easily reaches the hook on the snap-up, with no pressure on the torsion bar. The chain would need to be connected on the fourth or fifth link to achieve any degree of weight transfer.

Here we have the correct angle on the ball mount. The end of the torsion bar is 4" from the ground and the end link is 5" from the snap-up hook. In this picture it looks as though the torsion bars will drag on every bump but they will be considerably further off the ground once they are transferring weight properly.



TOP VIEW OF TOW VEHICLE, TRAVELING STRAIGHT



TOP VIEW OF TOW VEHICLE, LEFT TURN

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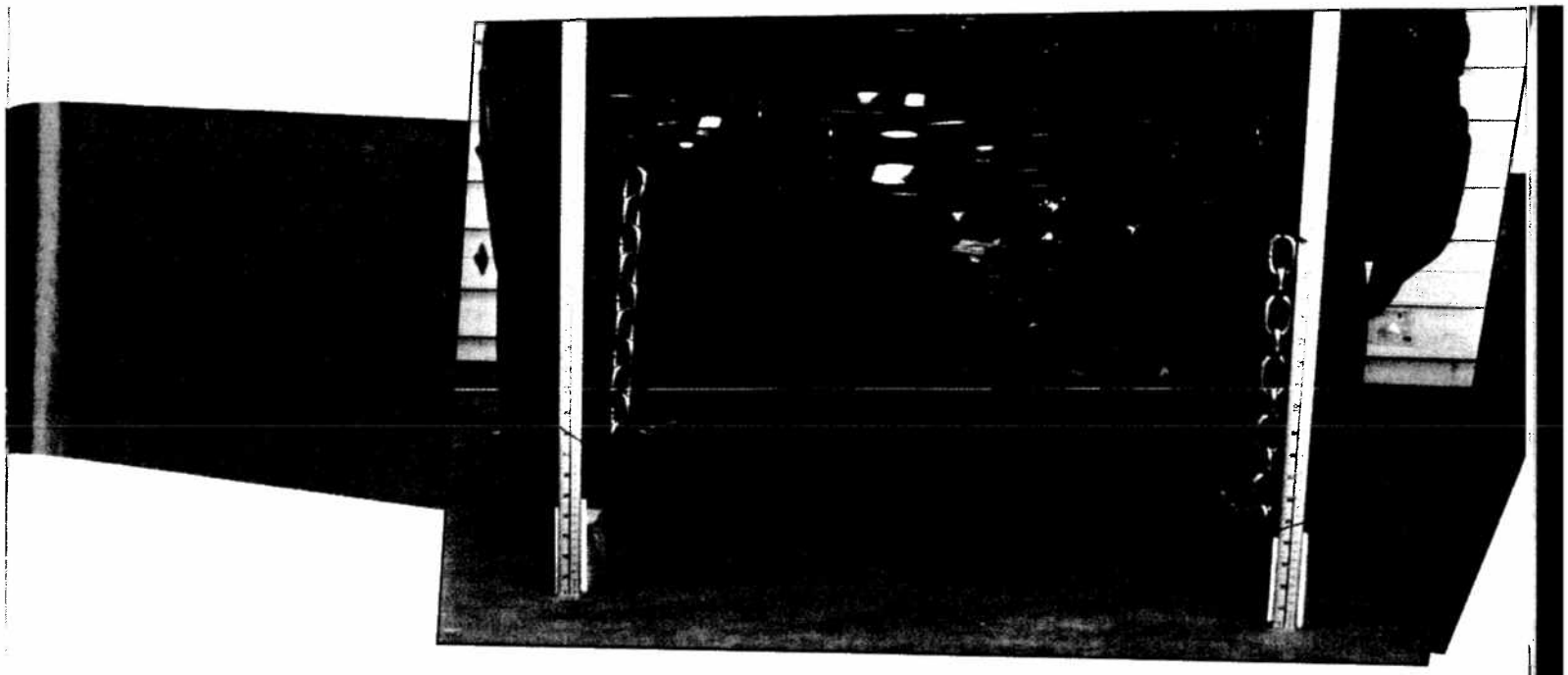
Connecting to the end link with this combination transfers the correct amount of weight forward. So having a significant rearward angle on the ball mount makes it easier to transfer weight. Using all of the chain reduces wear on the chain links and gives some flexibility in the position of the snap-ups.

However, the main reason for the rearward angle is to change the direction of weight transfer so we have additional traction in sharp turns and additional stability at high speeds.

When you connect your torsion bars, they transfer weight to the opposing front wheel and remove weight from the rear wheel on the same side. When the vehicle is turned, the lines of force move in the same direction as the torsion bar is pointed, so the bar on the inside of the turn will now transfer weight to the opposing rear wheel. The bar on the outside of the turn will point up the middle of the car.

When the ball mount is vertical, the axis that the torsion bars rotate on is also vertical. This means that no matter where the torsion bars are positioned in their rotation, the ends stay the same distance from the ground (the yellow line in the picture, opposite page) and therefore they exert the same pressure. This means the



torsion bars will transfer the same amount of weight in any direction they are pointing.

In a turn, the inside torsion bar is no longer aimed at the opposite front tire. It is pointing at the opposite rear wheel, so *it is trying to roll the vehicle over sideways*, rather than transferring weight forward. The bar on the outside of the turn is pointing towards the center of the car at the front, but less weight is transferred forward because only one bar is pointed at the front of the car instead of two.

On the angled ball mount we have a very different set of measurements. When the torsion bars are sideways (imagine the trailer in a 90 degree turn) there is no angle, so the distance from the ground matches the head bolted vertically. When the trailer is straight behind the tow vehicle the bars are 4" off the ground. When a torsion bar itself is straight behind the tow vehicle, it swings to as low as 3" off the

	FRONT		REAR	
	Right Corner *Outside of turn*	Left Corner *Inside of turn*	Right Corner *Outside of turn*	Left Corner *Inside of turn*
Tow vehicle without trailer	23"	23"	23"	23"
Tow vehicle with trailer in straight line	22 3/8"	22 3/8"	22 5/8"	22 1/2"
Trailer turned 22° with rearward ball mount angle	22 1/8"	22 1/2"	22 3/4"	22 5/8"
Change in height from straight line	- 1/4"	+ 1/8"	+ 1/8"	- 1/8"
Trailer turned 22° with vertical ball mount	21 5/8"	23 1/4"	21 1/2"	22 3/4"
Change in height from straight line	- 3/4"	+ 7/8"	- 1 1/8"	+ 1/4"
Height difference between ball mount positions (Straight v. Angled)	- 1/2"	+ 3/4"	- 1"	+ 3/8"
Increased vehicle lean with vertical ball mount	1 1/4"		1 3/8"	

With angle on the ball mount, the trailer wants to naturally settle in a position straight behind the tow vehicle.

ground. This arc of motion is illustrated by the red line in the picture (previous page).

When you turn with an angled ball mount, the bar on the inside of the turn that is pointing at the outside left wheel rapidly loses tension, while the one on the outside that is pointing at the front wheels even more rapidly increases tension, so you still have weight transferred to the front wheels as it should be.

The chart above shows the difference in weight transfer between the angled and vertical ball mounts on this SUV. As you can see, with the angled ball mount the weight transfer stays almost identical regardless of turns. With the vertical ball mount, the vehicle leans 1-¼" more. When you are turning, the center of gravity generally places plenty of additional weight on the outside tires, so you really do not want any extra stress from your weight distribution hitch.

In an emergency maneuver such as a sudden lane change it is possible to come

pretty close to 22 degrees of articulation. So with an incorrect ball mount angle, you can find that just at the time when you want the most consistency from your tow vehicle, its balance suddenly changes.

If your rapid lane change needs to come back to straight equally rapidly, the problem is exacerbated. You now have a vehicle that is suddenly rolling 2.5" side-to-side—on top of normal body roll due to the changing center of gravity. If you have a stiffly sprung tow vehicle you will not see the vehicle lean, however that does not mean you are not transferring weight in the wrong direction.

Another interesting conclusion from this example is that the rear leans a little more than the front. This means that the vehicle must have twisted a little, which is quite possible. (When we discuss tow vehicle chassis designs in a future article, we will come back to this.)

Those that are NASCAR fans are likely familiar with the term "wedging a car," where racers modify the weight on the tires with sway bars and spring rates to optimize traction on the continuous left turns. By adding angle to the ball mount we avoid "reverse wedging" the tow vehicle when turning.

Beyond making the tow vehicle much easier to control in an emergency maneuver, the ball mount angle assists with directional stability going straight down the road at highway speeds. Even in small degrees of direction change, the torsion bar on the outside of the turn gains tension much faster than the bar on the inside loses tension. This is because as a torsion bar bends it requires progressively more effort to bend it the same distance. With angle on the ball mount, the trailer wants to naturally settle in a position straight behind the tow vehicle.

Another way to think about it is to picture the forks of a bicycle or motorcycle. They always angle backwards at the top. This is why you can ride a bike with no hands. If the forks on a bike were completely vertical you would not be able to ride it "no hands" — it would be too unstable. The angle on the ball mount provides a similar function as forks on a bicycle.

These pictures and measurements were all done with a new 28' Airstream International CCD with a 1,000 lb. EAZ-Lift torsion bar. We refer to this as a tapered round bar style. This bar has more range of motion than some other torsion bar designs. A torsion bar that is not tapered at all would be the other extreme and have a very limited range of motion.

Stiffer bars can actually handle better because the weight transfers are exaggerated due to how rapidly they load and unload through their range of motion. The downside is that stiffer bars do exert considerably more pressure on the trailer "A" frame and the tow vehicle receiver. If the pressure is too much for the receiver, the receiver just bends and twists instead of the torsion bars, and the benefit of the stiffer bars is lost.

If you have a bolt-together ball mount, adding more rearward angle is fairly easy to do and well worth the time. Feel free to send any questions or comments to me at andy@canamrv.ca •••