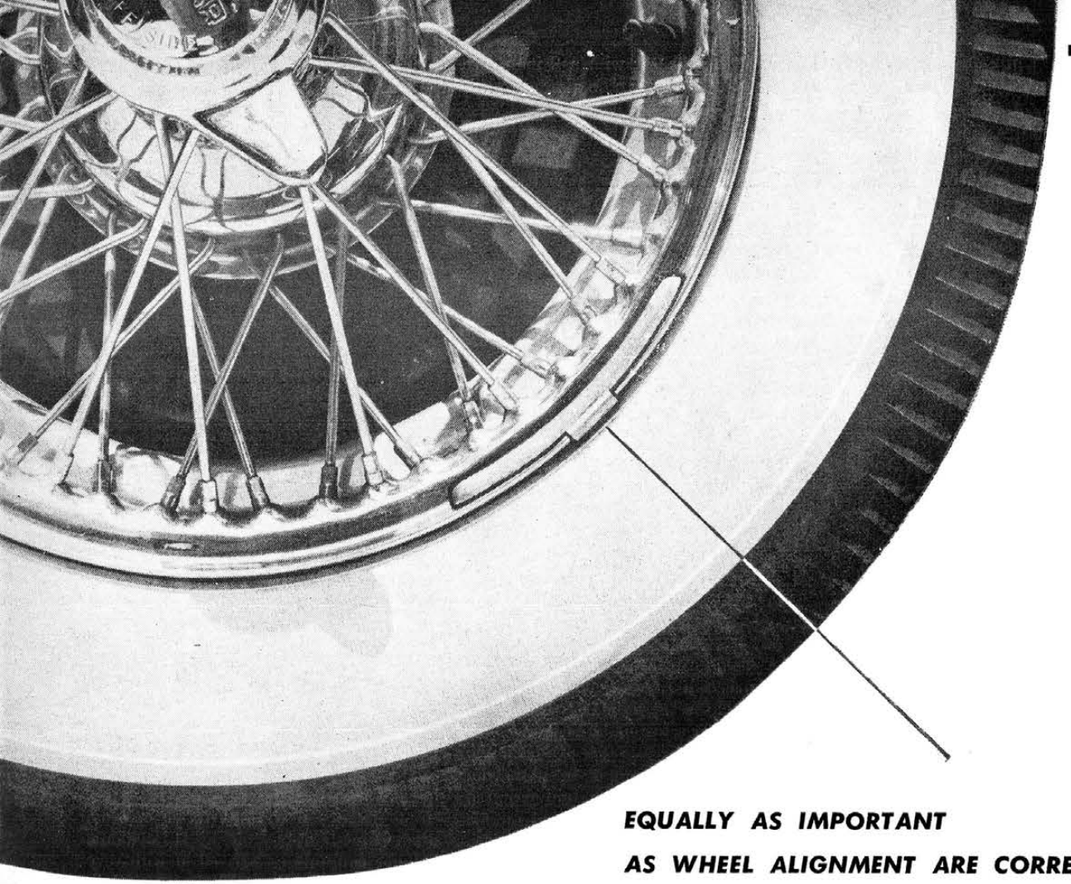

By Mal Meredith

EQUALLY AS IMPORTANT

AS WHEEL ALIGNMENT ARE CORRECTLY . . .

BALANCED WHEELS

THE PROPER balance of the front wheels and tires, along with wheel alignment and shocks, is another move towards the retainment of good steering and a smooth ride. Wheel wobble and tramp, high speed shimmy, can in some cases be attributed to wheel assemblies being out of balance. Tire wear is also affected to a large degree by balance conditions. The rear wheels should also be balanced. An unbalanced condition in the rear will set up vibrations that can affect operation of the front end suspension assemblies.

The phenomena of wheel wobble is due to vibration of the front axle around a horizontal axis through its center. As the axle is spring mounted and supported by the tire the whole assembly will have a natural vibrating period. This problem was studied in detail in Shock Absorbers (Sept. HOP UP). When we have a periodic vibrating force, as when the wheel assembly is out of balance, and this force becomes synchronized with the natural period of the suspension the result is usually a very troublesome wheel wobble condition.

Shimmy, you all have experienced to some degree at high speeds, is a violent flapping of the front wheels about the king pins. Shimmy is caused by the gyroscopic forces of the front wheels. At high speed the wheels act as gyroscopes and when the axis of rotation of a gyroscope is moved angularly a force is set up which tends to move the axis in a direction perpendicular to the original motion. This is the force that makes the toy gyro rotate or progress about its pedestal. This force can also be felt when a grinding tool or high speed drill motor is moved suddenly. When there is wheel wobble at high speed the movement of the wheel alternates in direction and therefore the movement in the horizontal plane caused by the above mentioned gyroscopic forces also alternates. This alternating condition is universally known as wheel shimmy.

You may see now that we have two separate conditions capable of inducing vibration (about the horizontal axis and about the king pins). Since these two conditions are so closely coupled a vibration of one will be accompanied by a vibration of the other. It is also evident that if one of the wheels has an eccentricity, or run out, or if the wheel is out of balance, the axle will raise and fall once for every revolution. The effect would be even greater if both front wheels were out of balance and their run-out points were opposite to each other. Therefore, as a guard against wheel wobble and shimmy the wheels and tires should always be balanced and checked for both lateral and radial run-out imperfectness.

The out of round condition of a wheel can present a very serious problem. The modern wheel is made in two pieces, the center section or hub, and the rim. As a result of the modern mass production methods many times these two assemblies are riveted together in such manner as to cause out of roundness. Another spot where fault can be found is at the lug holes.

An error in the drilling operation will often show up only when the wheel is turned at high speed. George Bagge, of Bagge and Son Wheel Alignment Specialists in L.A., has at least three cases a week in which new undamaged wheels are found to be out of round. If the wheel is a new one the only thing that can be done is to return it and demand a replacement. In the case of damaged wheels a competent wheel repair man can sometimes straighten them. If not they must be replaced before they can be balanced.

Tires are also a sore spot. Many cases are known where the wheel is true but the tire is out of round. This can be found by turning the tire at a high rate of speed on the balancing machine and placing some stationary object near the wheel edge. If the wheel is straight and there is still a hop then obviously the tire is out of round. Contrary to popular belief the tire is not cast from rubber as metal in a foundry. Each tire is hand made. The carcass is made up of layers of cotton or rayon with the rubber bonded to it. In the hand *building up* of these cloth layers the splices are supposed to be equally dispersed over the whole tire. But since in every factory the building of tires is piece work and the worker is paid for his production it is easy to see why sometimes the splices are uneven throwing the tire out of balance and out of round. In the many tires Bagge has balanced he has even found some in which the splices are all grouped in one spot. This causes a hard spot in the tire which cannot be detected on the balance machine. The spot will not show up until the tire is in use. When the tire rotates it compresses from the load on it, but when this hard spot comes in contact with the road it will not flex. Therefore, at high speed we have the aforementioned periodic vibration. The only way that a hard spot can be noted is a badly worn place on an otherwise evenly worn tire.

The importance of tire and wheel balance in high speed work cannot be expressed enough. The centrifugal force accompanied with a vibrating force increases with the square of the velocity of the tire. Therefore, a wheel that may have an out of balance force on it of three lbs. at 30 mph will be out twelve lbs. at 60 mph. This force will soar to over 27 lbs. at 90 mph. See Fig. 1. In this day of high speed driving correct balance is imperative. In the case of race cars and lakesters the wheels must be balanced both front and rear as the vibration will not only cause shimmy but will literally tear the tires and suspension apart.

When re-assembling a tire great care must be taken to make sure no foreign matter is left in with the tube. In the process of balancing, many things have been found inside tires. Coins, rocks, tools, etc. may seem like very light objects when they are held in the hand, but when they are inserted in a tire of large dimensions and whirled at great rates of speed the forces multiply the weight until the object is quite heavy. Bagge told me of a huge truck tire that was placed on his machine for balancing. As the tire was run up the vibration became so bad that it almost tore the machine apart. Upon dismounting the tire it was found that a ball peen hammer had been left between the tube and the wheel.

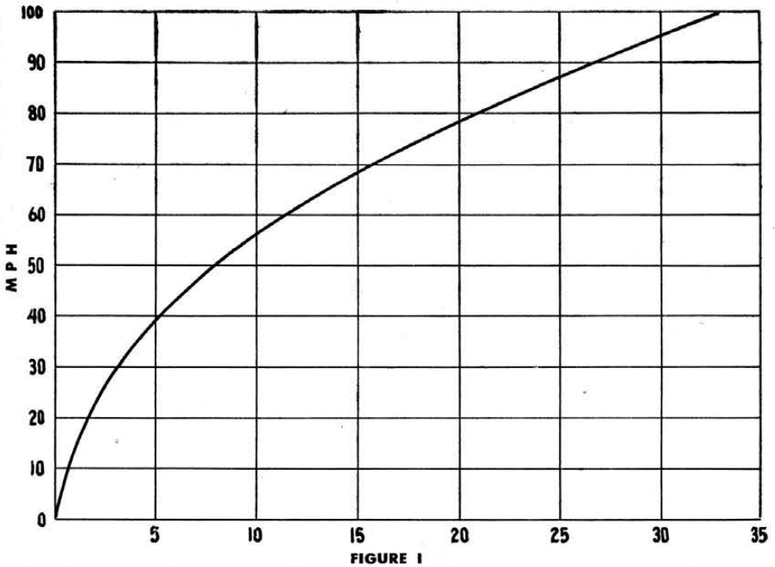

FIGURE I

CENTRIFUGAL force in pounds created by a 7.00-16 tire one ounce out of balance

There are many ways to balance tires. You have no doubt seen Joe at the corner gas station studiously indulged in rotating a tire until it stops, noting the point which is the heaviest, then rotating it again. After many tries he selects the approximate point at which the tire is heaviest. Then, affixing a weight at a point just opposite, says that the tire is in balance. This, at its best, is a very poor method for balancing tires.

There are two completely different types of wheel balance that should be explained. Static or stationary balance and dynamic or rotating balance. What Joe is attempting to do is arrive at some semblance of static balance. This is done by affixing a weight on one side of the tire to balance an irregularity in the same plane directly opposite. Fig. II. Dynamic balance can only be arrived at with very complicated machines. This type of balance must be obtained by placing weights in one plane to balance irregularities in a different plane on the same side of the tire. Fig. II. The correction of this fault will do much to rid the wheel of excessive wobble and shimmy tendencies.

There are many different types of machines for balancing wheels. With some the wheels do not have to be removed from the car. The wheel is first jacked up off the ground and then a second wheel driven by an electric motor is brought

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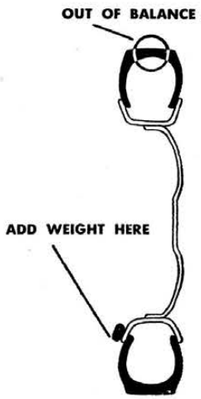

FIG. II

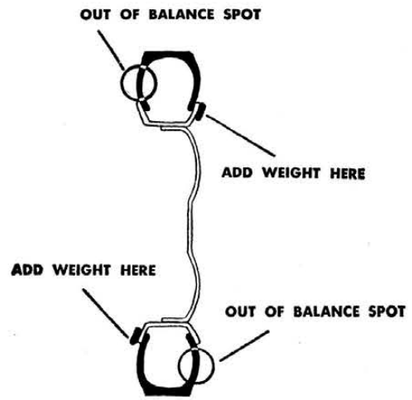

FIG. III

FIGURES II & III show the method for adding weights to obtain correct static and dynamic balance in wheel assembly

BALANCED WHEELS

(*Continued from page 41*)

into contact with the tire. This turns the tire and wheel at high speed. Chalk marks are made on the tire before it is turned. Under the tire is an electrical contact which is in turn hooked to a battery and light. As the tire turns the high spot or out of balance spot closes the contact causing the bulb to light. Since the light is positioned at the top of the tire the distance from the bright spot to the chalk mark is where the weight should be affixed in order to balance the heavy spot at the bottom. While this type of balancer has the advantage of balancing not only the wheel and tire but also the brake drum, only static balance is taken into consideration. Also, there are considerable human error possibilities involved as the distance from the bright spot to the chalk mark can only be guessed.

The best type of balancer is the stationary type. With this type the wheel and tire are dismounted from the brake drum and bolted to a mandrel on the balancer. First static balance must be arrived at. This is done in approximately the same manner that Joe at the gas station used. That is, the tire and wheel is set slowly in motion and the point at which the bottom of the tire, the heaviest spot, comes to rest is noted. The feature that Joe could not allow for, the added friction pressures of the wheel bearing, is compensated for in this machine. The bearings on which the mandrel run are the frictionless type. These bearings are lubricated with kerosene and actuated by a vibrator so that at the slow revolutions of static balance there will be no retarding force. This method is so accurate that when the wheel is in complete balance, the weight of only one penny inserted in the tread will cause that part to seek the bottom and the tire to rotate. Next we must balance for that important dynamic force. Within the machine is a series of weights, or hammer, which rotate with the wheel. There are two levers on the sides of the machine, one that will move the weights fore and aft in respect with the tire and one that will move the weights in the direction of rotation of the tire. See Fig. IV. A pointer is also provided which is mounted on springs. Vibration of this pointer shows that an out of balance condition is present. When the wheel is set in motion the oscillations can be compensated for by movement of the levers which in turn move the weights. The lever controlling the fore and aft movement is gauged to give the amount of weight to be affixed to the tire. The lever that controls the rotation of the weights will tell the position that the weights must be in to give proper balance. This process is repeated as many times as is needed until the pointer will remain stationary. Then and only then is the wheel considered in good balance.

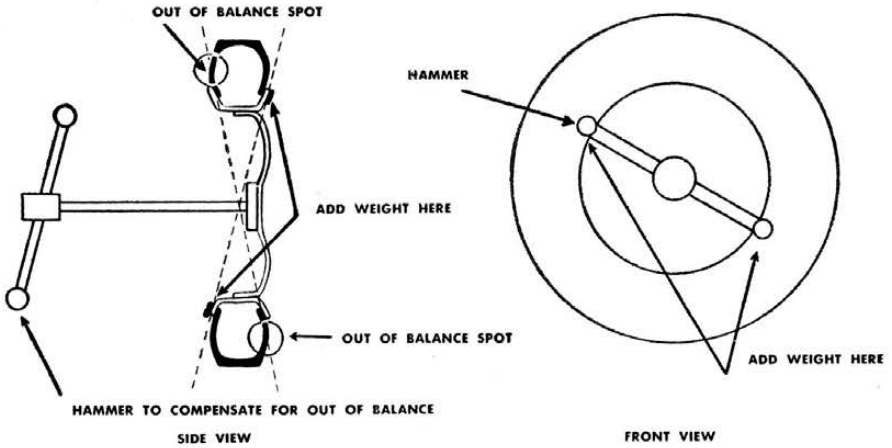

FIGURE IV

FIGURE IV shows how hammer on wheel balancer indicates where the weight is to be applied for a correction of the dynamic balance irregularities

With the advent of the low pressure tire and the life-guard tube the life of the tire balancer was made even more complicated. The large masses of rubber at a great distance from the center of the wheel on the low pressure tire make them very susceptible to irregularities. Recaps and re-treads also are a problem. Many times the cap is put on crooked or heavier in places. These faults are not only bad for balance but can also cause run out. When the life guard tubes were introduced it was found that they were almost impossible to balance. This was because of the great mass of the tube inside the inner tube. A mass of this quantity free to move about inside the tire is very hard to compensate for. Lately the lifeguard tubes have been coming out with webbing inside of them to hold the tube in place. This seems to have helped the problem to some extent for now a fairly good job of balance can be obtained with a low pressure tire equipped with a life guard tube.

You have seen, we hope, through these articles what wheel alignment, shock absorbers and wheel balance can mean to you. Mileage, both gas and tire, safety, and a good ride can all be had by taking care of your car. The money that you may spend for these things which you can not see is certainly not lost. It will be repaid to you many fold. By having a competent man do the work with good equipment I am sure that you will class it as money well spent.

KURTIS 500 KK

(*Continued from page 39*)

you can afford more, you can buy the complete front axle setup, minus the Ford front spindles, brake assemblies, drums, etc. The same with the rear end. We bring this out because many readers have a source of used parts of the Ford variety or can buy them at the nearest junk yard.

Well, that's it. Just how well this particular setup will fit into the car you plan to build is up to you. We at HOP UP Magazine, although it is not our policy to endorse any particular manufacturer's product, think Kurtis has a good idea. It may well help many would-be home car builders over the rough spot of not having the knowledge or the equipment to build a good chassis. Let's hear what you think of this plan of America's No. 1 chassis designer and builder.