STEERING AND CHASSIS

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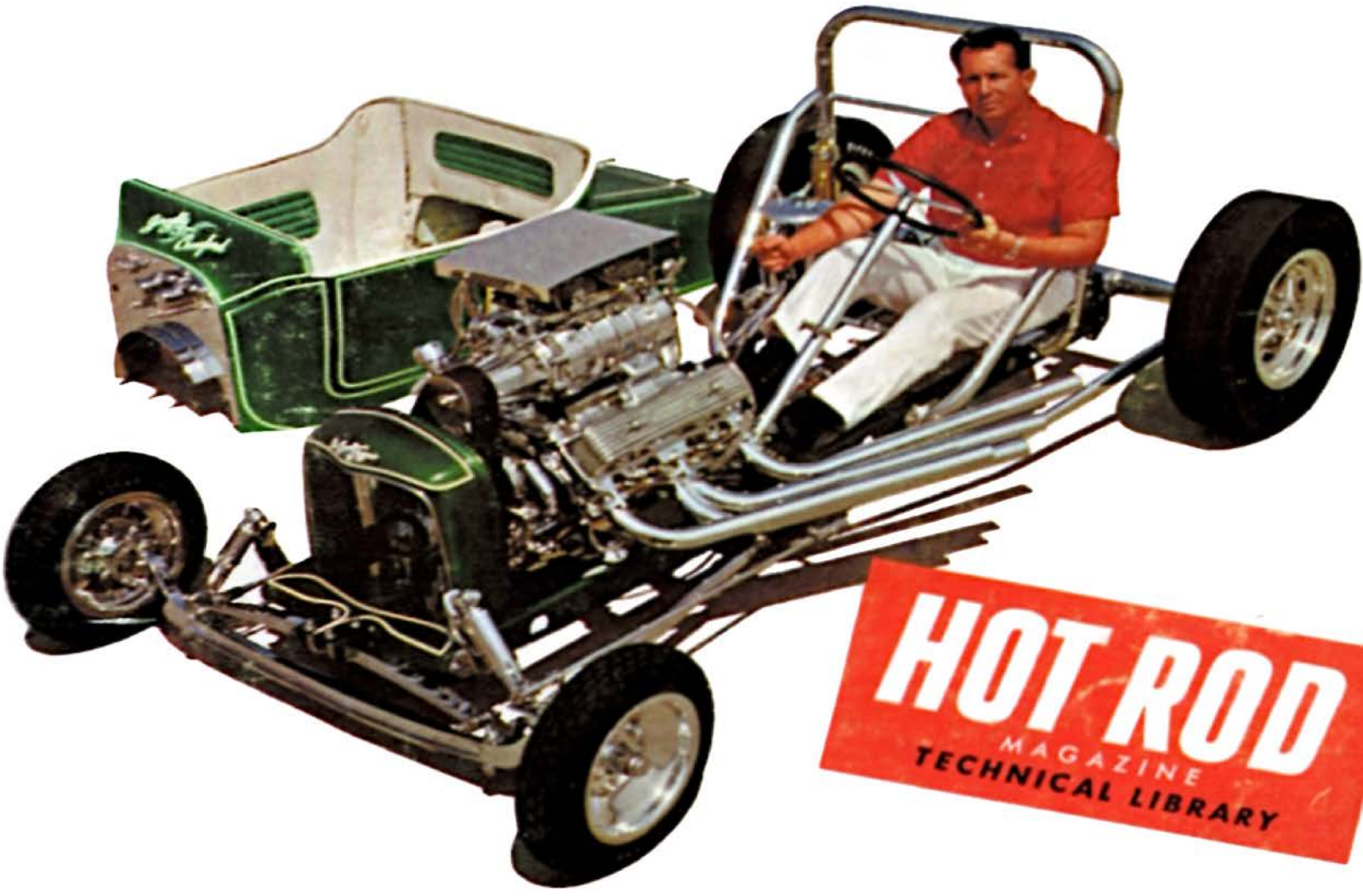
By The Editors of *HOT ROD Magazine*



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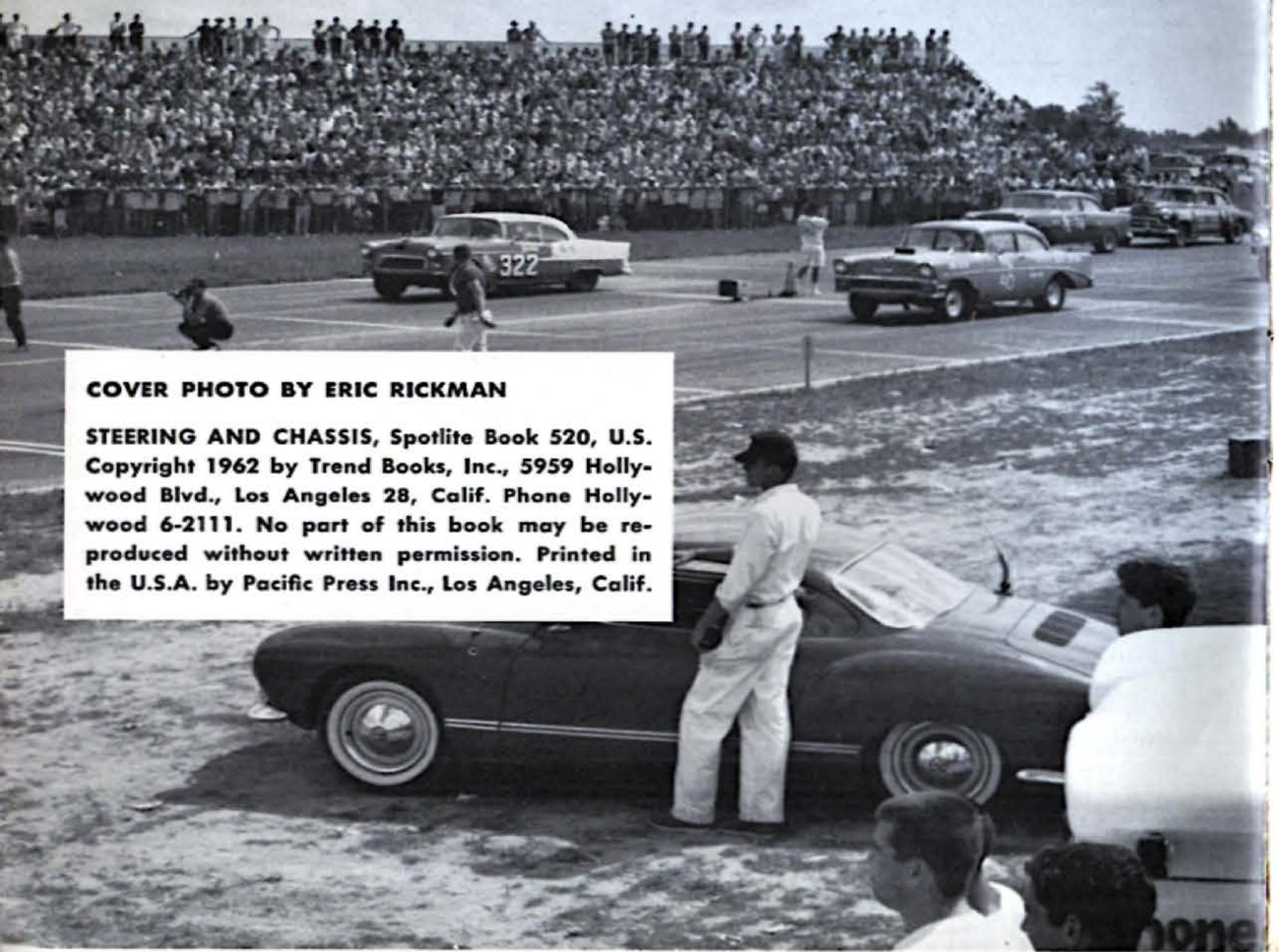

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INTRODUCTION

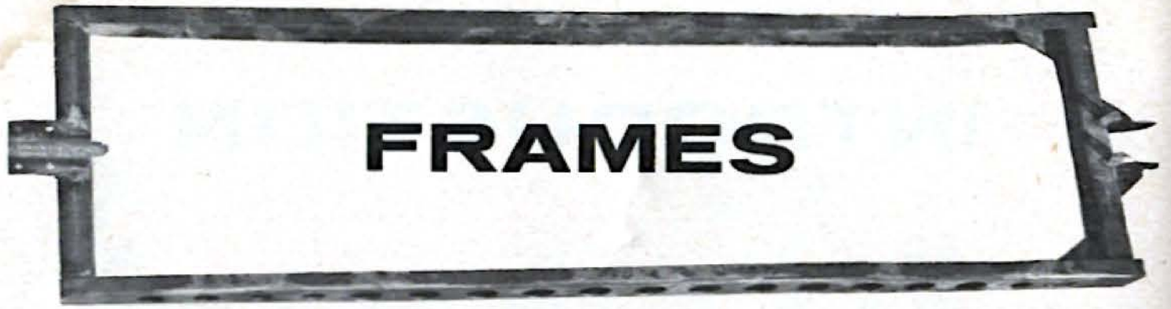
OTHER than the final finishing touches, nothing seems to require as much effort and time in construction of a hot rod as does the basic essentials of the chassis. And by chassis, we here refer to the item often called the "running gear," i.e., the frame, front and rear end components, and the steering.

Ideally, a rodder should be able to spend his spare time collecting a mass of automotive parts and, some cold and rainy evening, build up the "perfect" chassis for his future car. Unfortunately, such is not the case by a long shot. On second thought, perhaps it is really quite good that a ready-made chassis isn't immediately available.

Consider, if you will, the average rod enthusiast in, say, Podunk Junction, U.S.A. He is familiar with rods, having seen a few street jobs in nearby towns and some competition cars from over-the-fence at the drag strip. When it comes to building a car of his own, he must rely fully upon his memory, a few out-of-focus snapshots taken with his box camera, and the pages of magazines such as Hot Rod. Of a consequence, our friend ends up with a battered old Model A body and frame, a '51 Olds engine in need of thorough repair, a tired '41 Ford sedan to scavenge parts from and much enthusiasm. Much enthusiasm, that is, for the first couple of weeks. After that, all time seems to be spent in re-doing previous work following costly mistakes. But finally the job is complete. Our friend has learned much in building his first roadster and is seriously considering building another one after awhile. But first he must drive the present car. Ooooh! It only hurts when we laugh! He bends the steering wheel trying to turn the bear. The brakes need a truck driver to operate them. The doors fly open every time he goes diagonally in or out of a driveway. Squeaks are everywhere. The springs seem to have been welded together and the shocks don't stop the shocks. In effect, what started out as a battered old Model A is now a shiny, powerful, washed and polished battered old Model A.

Story sound familiar? We're willing to bet it does, 'cause we've been in the same situation ourselves. A situation where a little learning can be doggone disheartening. But then, if everyone knew everything about building rods, there wouldn't be much fun left in the sport.

What we propose to do in the following pages (alas, all too few, we feel) is to assimilate many of the tried and true (and some not so true) aspects of hot rod chassis construction. When you lay this book aside we hope that you will be at least familiar with the various types of hot rod frames, front end components, rear end units, etc. It would dictate a book many times over the size of this one to convey all the necessary information to make you an expert on the subject of automotive running gear, but from now on you will surely be able to perceive the problems of good chassis construction and how to apply this knowledge to your next rod. Uh, slam that door for us will you? We've gotta get home and check that center crossmember again.



FRAMES

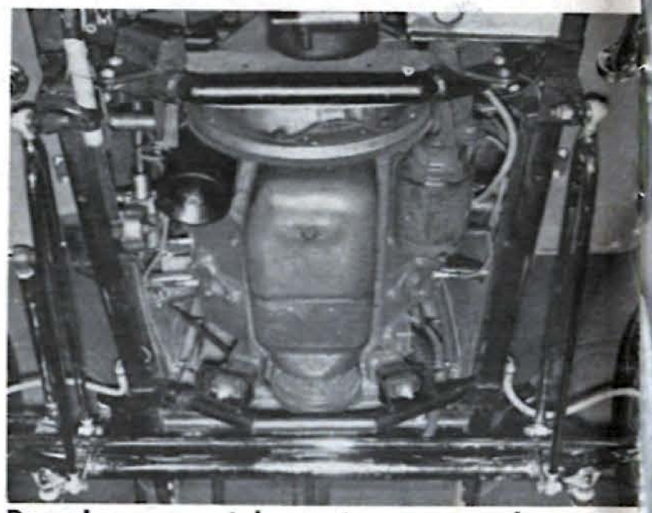
SINCE it is a general assumption that a major portion of a car's final appearance and performance lies in the basic frame, let's delve into that subject a bit. We'll confine our investigation of the frame to its relationship to hot rods. More specificially, street operated rods.

The average rod builder uses a standard production car frame, or modifies similar material for his car support. Most of the time the rodder will select one of the older, easily obtainable, ladder-type frames made of mild steel channel. These frames are usually quite inexpensive and fall into one of two categories: those with absolutely straight main side rails and those having either a kick-up at the rear, at the front, or both. Model T and Model A frames are good examples of the former; early Chevy, 1932 and later Ford frames represent the latter.

BASIC APPROACHES

If we are to consider a frame that is to stay relatively unaltered, then we will be concerned primarily with small modifications. Such a situation would exist if we were to build up a Model A using stock Model A frame rails. Assuming that this car would gain any lowering by modifying the body, it would not have any major frame changes. It should be cleaned and the areas around all rivets inspected closely for cracks. Cracks should be welded. Check the frame to see that the side rails are straight and the entire unit is not twisted or bent in any manner. Small deviations may be corrected at home, but something big like a major twist in the entire structure should be entrusted to a frame shop. It doesn't cost a great deal.

Minor changes to the frame such as shock absorber mounts, new engine mounts and miscellaneous braces may be welded on while the frame is in its bare state, providing you do a little thinking and use the ruler often. It'll keep you out of trouble later. Either



Dean Lowe uses tube center crossmember under Chevy engine in 'A' frame. Extra tube front crossmember supports mill.

LEFT—A basic rod frame made of Model A side rails drilled for lightness and "bulldog" front/rear crossmembers. Approach is basic but strong.

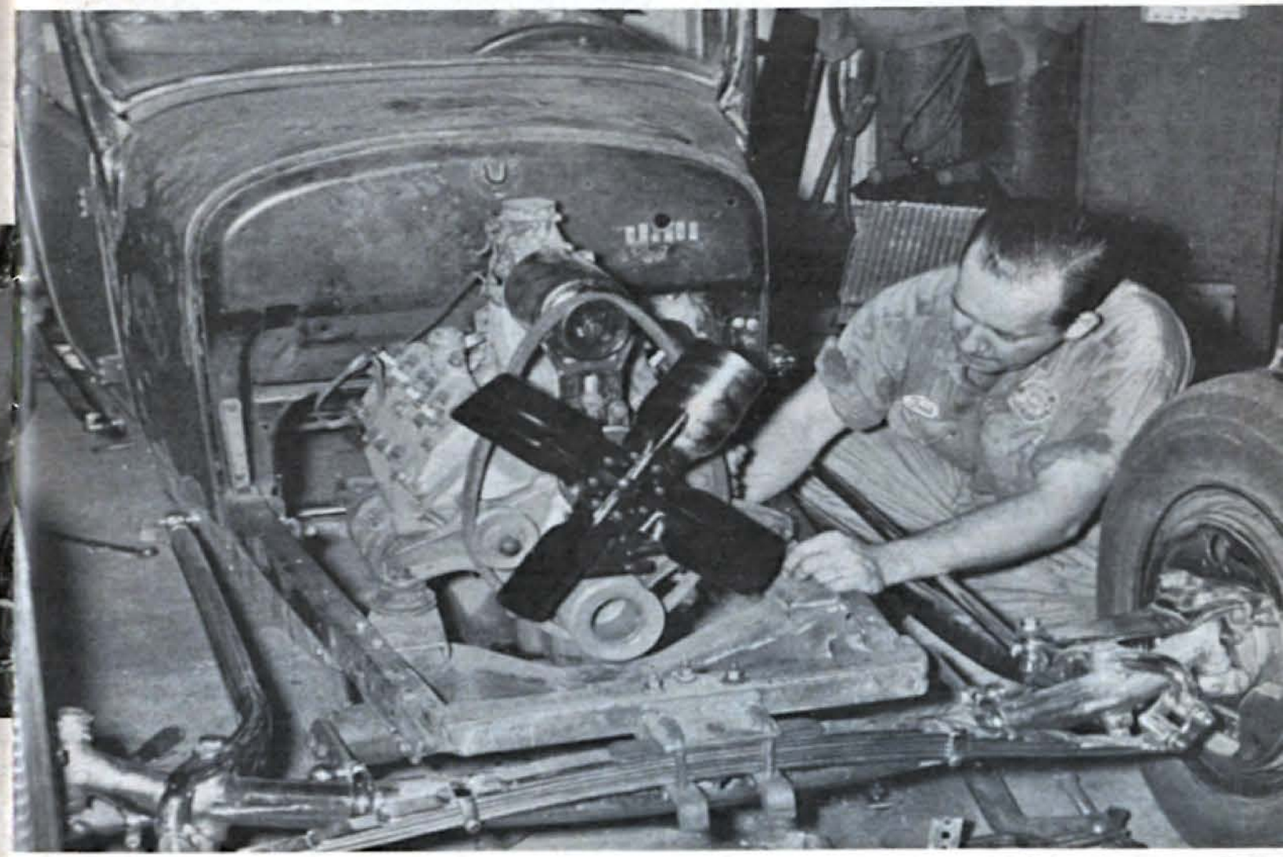
sandblast or wire brush the frame good and apply the paint. Frame paint is available, but it isn't as pretty or as permanent as regular lacquer or enamel.

FRAME MODIFICATIONS

Of course, now we get into the meat of things. To simplify, suppose we take each area of the frame separately. Starting at the front of an average frame of either category mentioned above (straight or kicked), it will be noted that some kind of front crossmember is used. In the case of pre-1949 Fords, this crossmember doubles as front engine mounts and provides a position for the Ford transverse spring. On early Chevy's, etc., semi-elliptic springs are used. Let's confine our discussion to the Ford, since we don't have room to become too precise. Suffice it to say that elliptic springs work very well and modification problems to lower the front of a car having them may be kept to a minimum by using a dropped axle. Use lowering blocks at the rear.

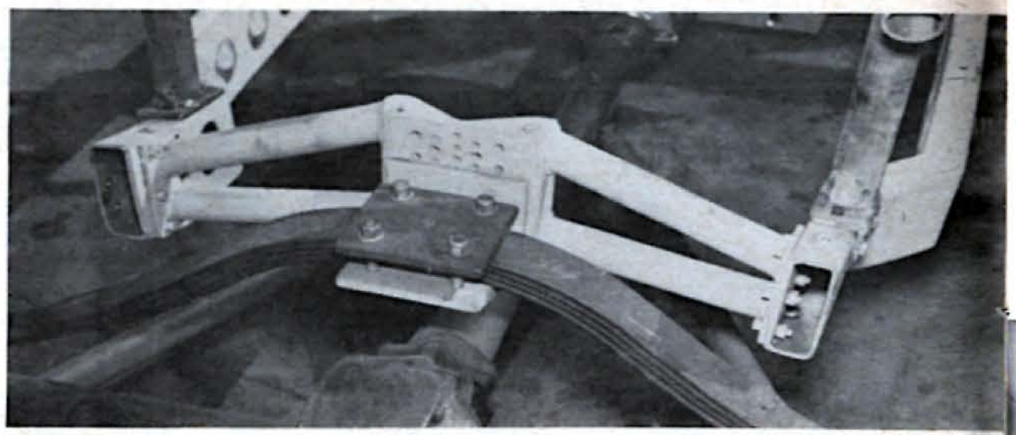
The normal desire is to lower the car, so we will want to do something in the front crossmember area. If the car is a 1934 or older Ford, it will

Taken many years ago, this photo shows that rod building hasn't changed much. Reinforced channel 'T' frame uses Ford V8 front crossmember as engine mount, another crossmember with perch for front end. Note steering arm, bent radius rods.

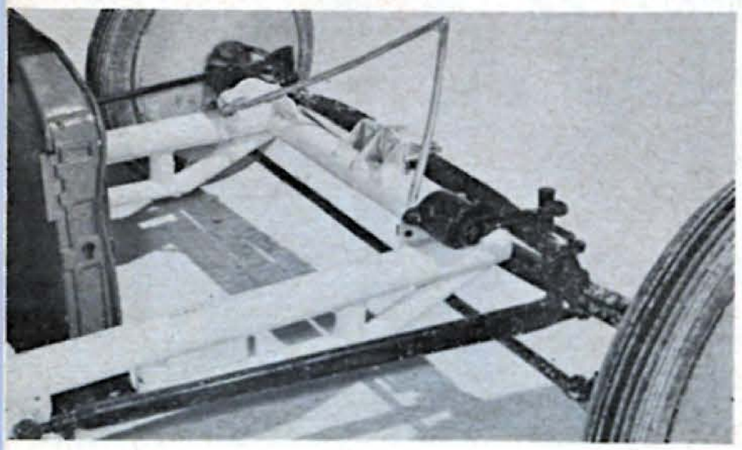


have the spring positioned above the axle. 1935 and later Fords have the spring mounted ahead of the axle. If the later front end is used with the older frame, the wheelbase is shortened approximately five inches. Perhaps this is OK with a non-fendered car, but the tires will ride too far aft of normal position on a fendered car. If we want to install a complete 1940 Ford front end assembly in a pre-'35 frame to take advantage of hydraulic brakes, we may do so. Merely weld a plate of ¼-inch steel (with proper gussets) off the top of the front crossmember. This plate is centered on the crossmember and extends forward some five to seven inches. Drill holes to accept the '40 spring U-bolts and you're in business. The normal high arch of the '40 spring should easily clear the frame horns. This is a quick way of using a later front end while keeping the wheelbase constant.

In case the frame is to ride really low, then some modifications to the standard crossmember must be made. If you have a '32 through '34 Ford and want to get a couple inches extra drop, just chisel out the stock front crossmember and replace it with a Model A unit. Bolt or weld or do both to secure the new unit. If even more drop must be had on either an 'A' or later Ford, (remember, we are discussing primarily 1934 and older Fords and similar frames. Other and later frames usually have sufficient drop to them and require work in the front suspension department to bring them down to earth.) a new front crossmember must usually be made.



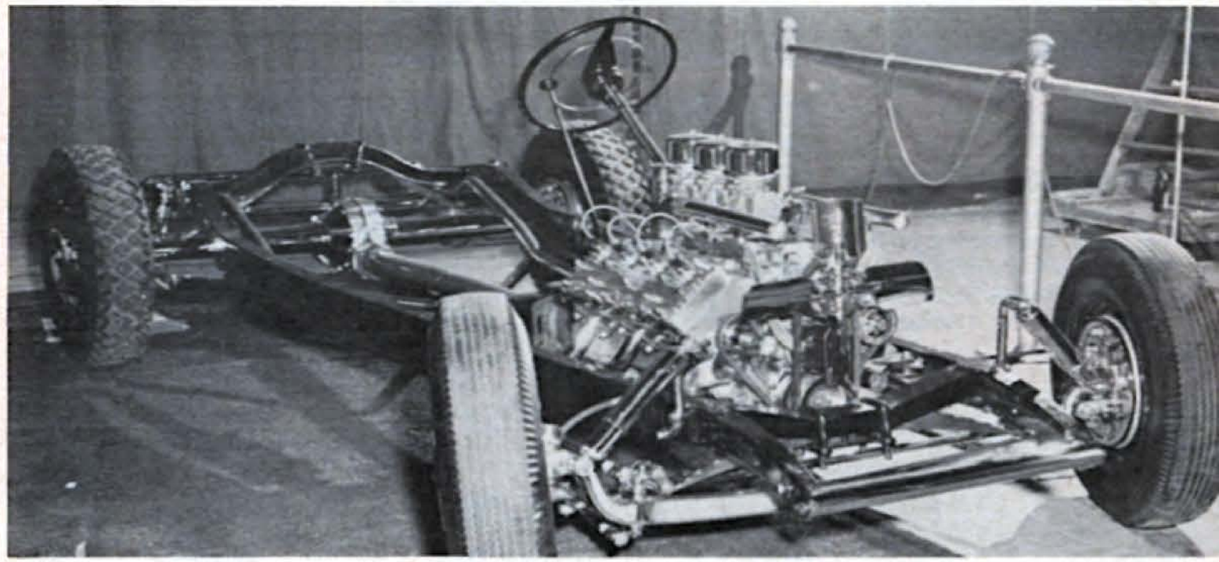
Competition car rear crossmember has adjustable spring perch for four-leaf 'A' spring mounted ahead of rear end. Idea works.



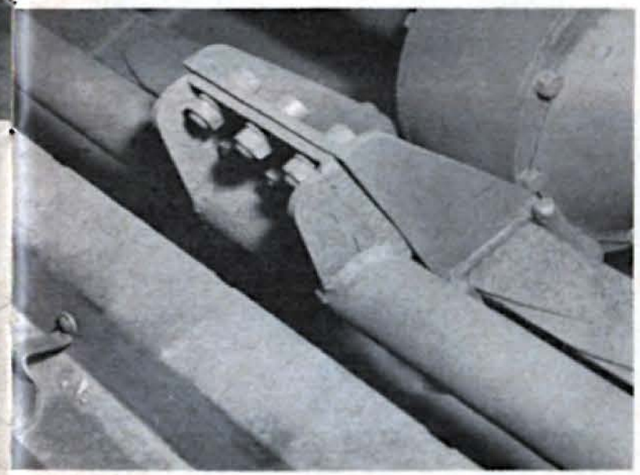
Tube framed Bonneville car has complete Model A front end bolted to adjustable "bulldog" perch. Shocks are Houdaille.

If the car in question has fenders, then the frame horns will probably need to be retained. This dictates limits to the drop. Here the usual method is to replace the crossmember with a new one made of appropriate width channel. This gains an inch or so, but not much. A word of caution here; most radiators are built to fit the front crossmember, and any variation from stock should be considered with the radiator in mind. If no hood is to be used, or more length in the engine compartment is needed, then the radiator may be moved ahead of the new crossmember.

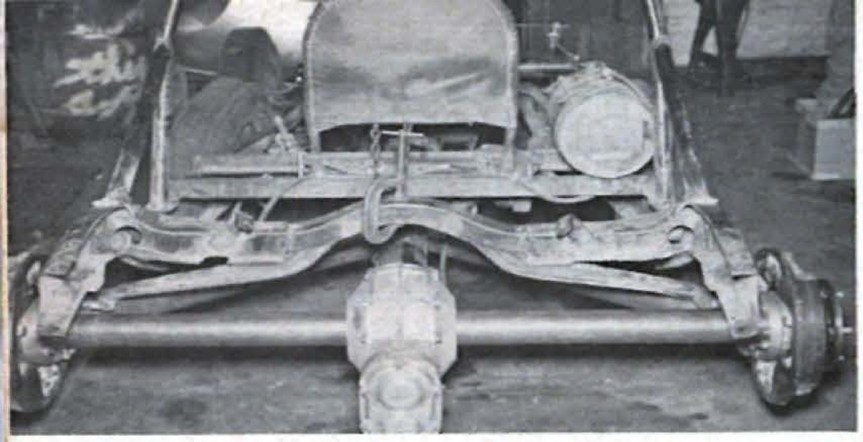
Now, should the rod be of the fenderless variety, considerable drop may be achieved through the crossmember. Normally, square or round tubing (an old driveshaft housing works well) is used. The stock crossmember is removed and the front edge of the new member positioned between the main rails from ¼- to ½-inch behind the rear edge of where the spring will finally be secured. Frame horns are cut off. Sheet stock approximately ¼-inch thick is used to form a new spring perch ahead of the crossmember. Now is the time to determine just where the frame should be in relation to the center part of the axle and also to the ground. Remember that oil pan. The spring perch



This is a hot rod chassis. Taken at car show in early '50's, machine has 1932 frame, dropped beam axle, tube shocks, hydraulic brakes, 'A' rear crossmember.

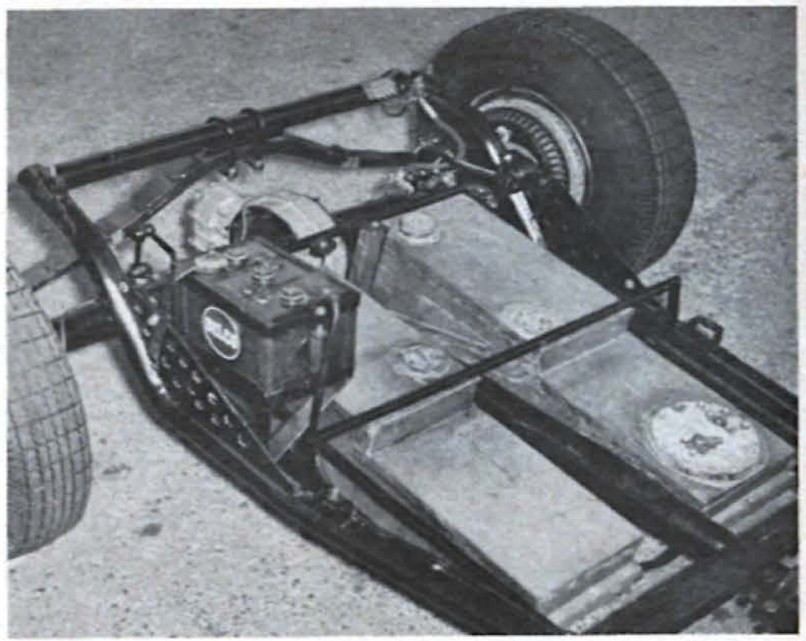


Tube rear crossmember has vertical perch, like spring perch. This way height of car at rear may be changed at will.



For quick-change clearance, 'T' rear crossmember section was spliced into '32 crossmember. "T" spring is also used.

Tubing was used for frame of this rod. Kick up was braced by drilled gussets, 'A' spring bolted below tube rear crossmember.



Tubing crossmember with transmission mounts bolts to 'A' frame.

may be built any number of ways, and at any height. The normal procedure is to place a plate horizontally (about four inches wide and five to eight inches long) at the top of the crossmember and weld it on, along with suitable bracing. Locating holes for the spring centerbolt and the U-bolts finishes the job. If the frame is going to have extreme rake in the front, you might consider building in a slight upward tilt to the spring perch to allow easy front end alignment later on.

The center crossmember of 1932 and older Fords is a simple structure. It goes straight from one side rail to the other. If you plan to use a Ford transmission of the pre'49 type, you probably won't have to change the '32 center crossmember, no matter what engine you select. If you use a '32 or later transmission in an 'A' frame, then you must modify the center member.

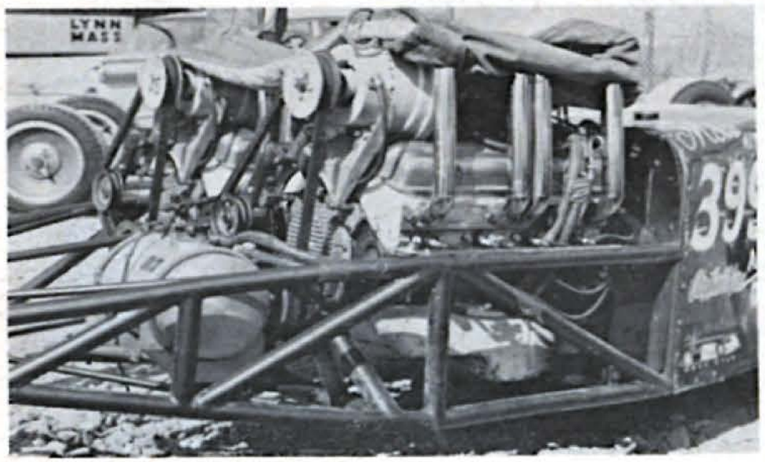
One modification is to put a '32 crossmember in the 'A' rails. To do this, you must narrow the deuce crossmember slightly. Align the top of the crossmember with the top of the frame. The top-to-bottom width of the '32 member is greater than the 'A', so it must be cut and fit at the outer extremeties of the bottom. Easiest out here is to weld the new member in, after making sure it is aligned properly with the rest of the frame.

1933 and later Ford frames contain an X-type center crossmember. This is a good unit and helps keep the street rod frame rigid. It may be kept as is, or it may be modified and used in other frames.

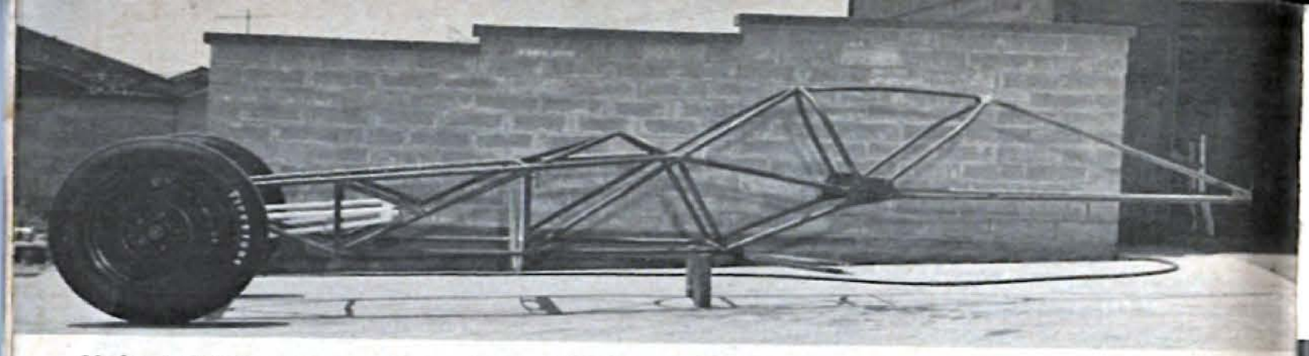
If a tubular center crossmember is necessary, it may either be routed below or above the transmission. Some cars route it above the trans and mount various items such as clutch and brake pedals there. The easiest routing is below the gearbox. In such an instance, a short tube is positioned below the transmission mounts. Tubes are then fit between it and each side rail and welded or bolted in place. Transmission mounting pads may then be welded to this member.

The rear crossmember is much the same as the front. If the floor at the rear of the body is not to be disturbed,

Front crossmember with bulldog perch is placed between 'A' rails, welded.



Modern frame design shows up in Jack Moss' twin Chevy powered dragster. Many new drag cars are going to double tube frames.



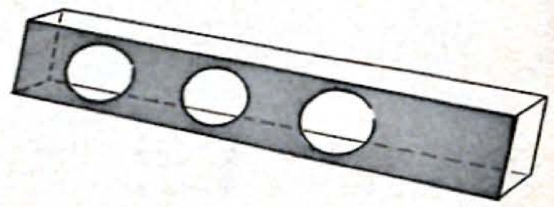
Light tubing was used to form this Bonneville car. An aircraft principle, structure is extremely light and very rugged. Such designs should be engineered first.

then lowering at this point must be made primarily at the spring(s). Otherwise, the sky is the limit. One method of dropping a '32 frame and at the same time gaining the ride advantage of a Model A spring is merely to put in an 'A' crossmember and spring. Not much lowering here though. '32 and later Ford rear crossmembers may be flattened by cutting V's (wide part up at outer ends, wide part down just outside U-bolts) in them and welding the V's up when the desired drop is attained. A piece of channel may also be used, or a tube crossmember, with the perch off the rear. Adjustable perchs are often made at the rear to change weight transfer or rake for various reasons, mostly competitive. These are the usual crossmember changes incorporated in rod frames. There are countless variations on these themes, and the only limit to anything you might do is your imagination. Just do a little planning and measuring before you start and you won't have to do the job twice.

Modifications to the side (or main) rails of the frame may be grouped into a few categories: "C-ing," "Z-ing," "double Z-ing," "Stepping," and "Boxing." Each of these approaches has evolved over the past years to serve a distinct purpose. As such, they should be considered for inclusion on a hot rod only if they will serve a purpose. Nothing is ever gained by modifying the frame just for the fun of it. Except, possibly, a few headaches.

"C-ING"

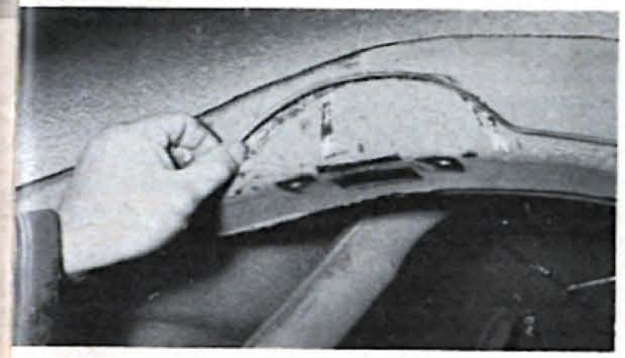
C-framing, or C-ing concerns not the method of lowering a car, but rather lowered cars. How so? Well, any restyled car just seems to look better if it rides closer to the ground. Certainly Detroit designers would like to bring their creations down to earth, but all sorts of restrictions enter the picture. So it is that one of the first customizing techniques undertaken by the rodder is modifying the suspension to drop the overall height of the car. Surely everyone has seen a car modified in this manner, at least to some extent. And just as surely, it has been noted that the car usually rides like a lumber truck. It telescopes every irregularity in the road. Why? A little matter of suspension bottoming on the car frame. And don't let anyone tell you that this is normal, 'cause it isn't. That's where C-ing comes in. This is a procedure normally ascribed for customs or late model cars and probably will seldom if ever be considered for older rod-material machines.



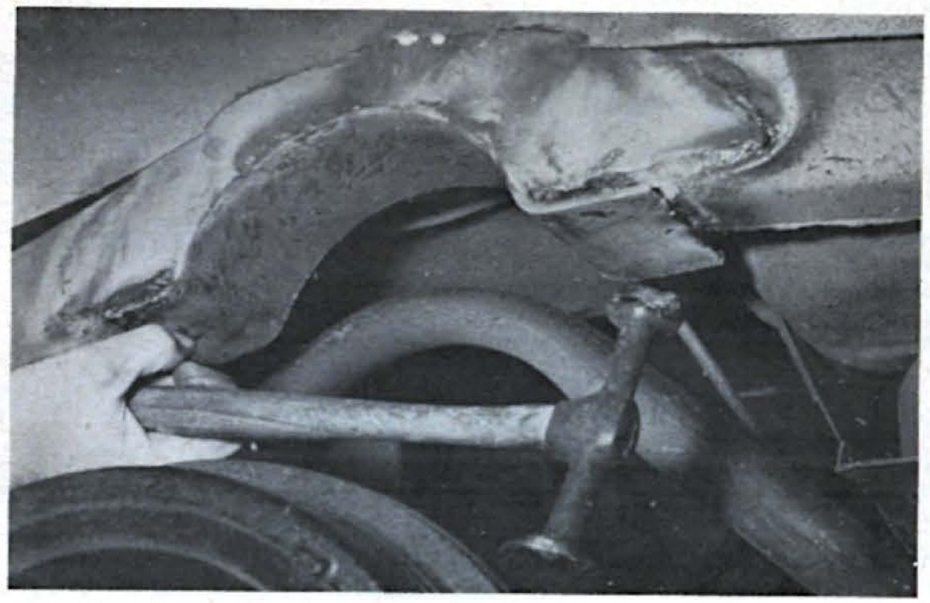
Frame boxing is easy. Just weld flat plate to inside of channel frame, drill it full of holes for some lightening.

In C-ing, a section of the frame rail is removed where the stock rubber bumpers come into contact with the axle housing (rear) or A-frame (front) on hard downward travel. By relieving the frame (1½ to 2 inches or more) at this point, you actually gain back about two thirds of the travel area that was lost by the initial lowering process. The car height isn't changed, just the area available for the axle(s) to travel up and down in. This small amount is enough to spell the difference between a good and a bad ride.

To many, the thought of cutting away a section of the frame may sound a bit on the radical side as it might weaken the frame. But as done correctly and carefully, no adverse effects have been encountered by top custom shops who have been doing C-ing for many years now. It must be remembered that if any car is going to be dropped to the



ABOVE—In "C-ing," first mark where frame to be cut, bend welding rod to shape. RIGHT—Transfer shape to sheet stock and make plate. BELOW—Weld plate to frame, bend and weld in plate in open bottom area. Extra clearance is about 5 inches total, helps the ride.



ground, several complications may arise. One of these is the driveshaft tunnel. In the case of frame C-ing, merely make the driveshaft tunnel higher the amount of the "C" (at the rear, tapering to normal at the front) and you're in.

If the C is to be performed at the front, just mark a section of the frame bottom edge where the rubber bumper is and cut out with a torch. This section is usually 2 inches wide and from 8 to 10 inches long (as long as the lower A-frame at that point). The edges of the cut are then boxed in for some added strength, but mostly for appearance. That's all there is to the front.

At the back, remove the rubber bumper which is usually on the frame. Scribe the section of the frame to be removed. It is directly above the rubber bumper area, and is approximately the shape of a half circle. Its height will be determined by the width of frame rail at that point and how much extra rear end travel you want. Average is 2½ inches. Bend a piece of welding rod to this shape for a pattern and transfer to a ¼-inch steel plate. This plate is in effect a sort of fishplate that is used as an extra support around the C area. Weld the plate to the frame and cut out the half-circle, or C. Next bend a piece of ¼-inch plate in the shape of the cut out area (C) and weld into the half-circle. This again boxes the frame for strength. And that's about all there is to "C-ing." Quite simple, but also very effective if a good ride is to be had in a radically lowered car.

"STEPPING"

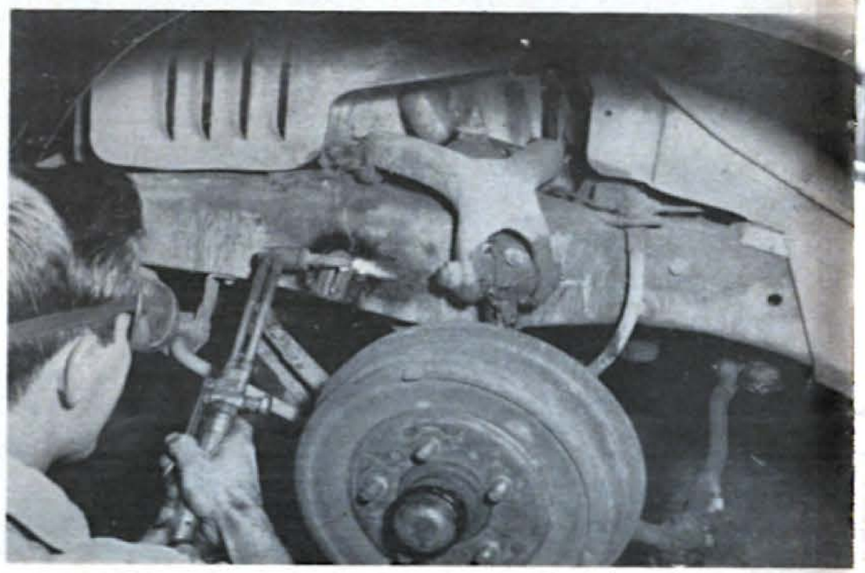
There are two points against most custom or late model car lowering, limitations of drop and loss of handling. In stepping the frame, you can go clear to the ground if need be without too great a problem since suspension stays pretty much stock.

A step-up is an entirely new piece of frame work adapted to the present frame to give as much clearance as necessary over the rear axle. The amount of clearance in C-ing is limited by the width of the frame side rail. Customizers generally feel that the average step should be about 5 inches. Combined with 3-inch lowering blocks, this brings a car pretty far down and retains excellent ride. And don't forget that the springs may be de-arched, too. In stepping, the entire area over rear end and driveline is generally removed. After the step is finished, this trunk area is rebuilt, but it then is higher in the car than before. The step looks something like the C, but is more pronounced. It is made of ¼-inch sheet stock, boxed for rigidity and welded to the existing frame. In side views, the frame is horizontal 'till just before the rear axle area, there it goes sharply up for the desired height, goes back horizontally the width of the axle area, then drops sharply again to the frame. This step is usually just wide enough to slip down over the existing frame, where it is welded into position. The original frame inside the step is then cut away.

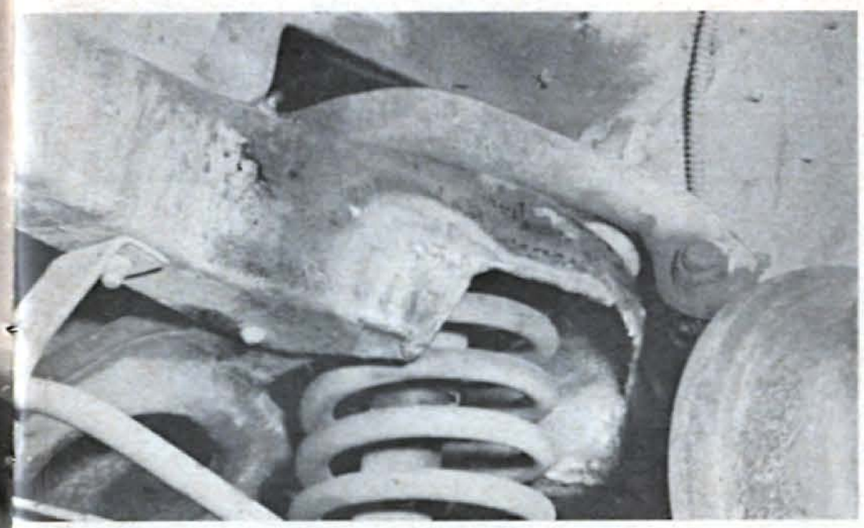
The step requires much body panel modification in the car interior, and we only mention it to show the work good customizing requires.

"Z-ING"

We have reserved this term (often called "kicking") exclusively for older cars and/or specially built cars that usually have transverse springs. In affect, this is similar to a step, only half-so. In Z-ing, the frame extends to the rear (or front, whichever the case may be) to just before the axle. It then goes upward to some predetermined height, and is then continued on backward as normal. As you can see, this just changes the relationship of the rear spring perch or crossmember to the rest of the frame. Z-ing isn't hard, but it does require some thought. There are two general methods of approach.



If lowered front end bottoms, mark area 2 in. deep and as wide as lower A-frame on bottom of frame. Cut with torch.



Front and rear edges of cut away area are boxed for strength. Extra travel room for front end is apparent here.

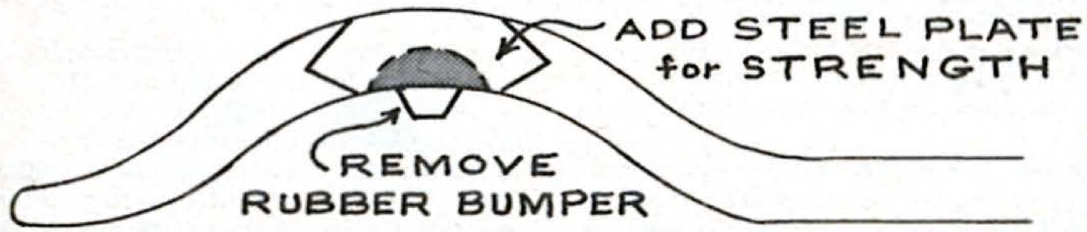


Illustration shows how rear end is marked, cut away, plated, and re-boxed. Frame is not overly weakened, project is easy.

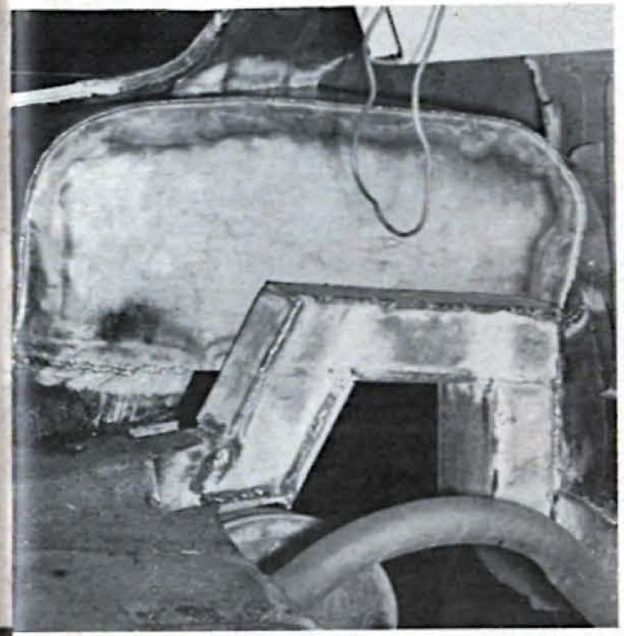
In stepping the frame, first determine shape and height of step, make a template. Floor above driveshaft and rear end must be cut away.

Make step of heavy plate arc welded together. Keep measurements exact for best final fit.

If the frame is like a Model A where there are no frame horns sticking out behind the rear crossmember, one of two things must be done. Either decide on a drop the width of the frame or add a section of channel the desired length of Z or kick. In either case, don't just cut the frame in two with a vertical slice. Decide where ahead of the axle it is to be modified, and cut the two rails on a 45 degree angle. If such an angle is used, the rear section will sit right on top of the front section, and the overall length will have remained constant. For a kick the width of the frame, just weld the two pieces together and fishplate or box for strength. If a big kick is necessary, add a piece of properly cut channel between the two frame ends, and then fishplate or box. Just remember to measure the operation often to keep everything lined up.

If the frame has extensions behind the rear crossmember, such as a '32 or later Ford, another procedure may be used. Find the forward point on the frame where the Z or kick is to be. Cut a V-notch in the frame rail from the

top going down to, but not through, the bottom edge of the frame rail. Measure backwards the length of the desired kick (taking into account the width of the frame rail twice) and cut a similar notch. This time notch from the bottom up, taking care not to cut the top frame edge. Bend the frame up, then back down, and you have a Z. Weld and strengthen with a plate or box. Now



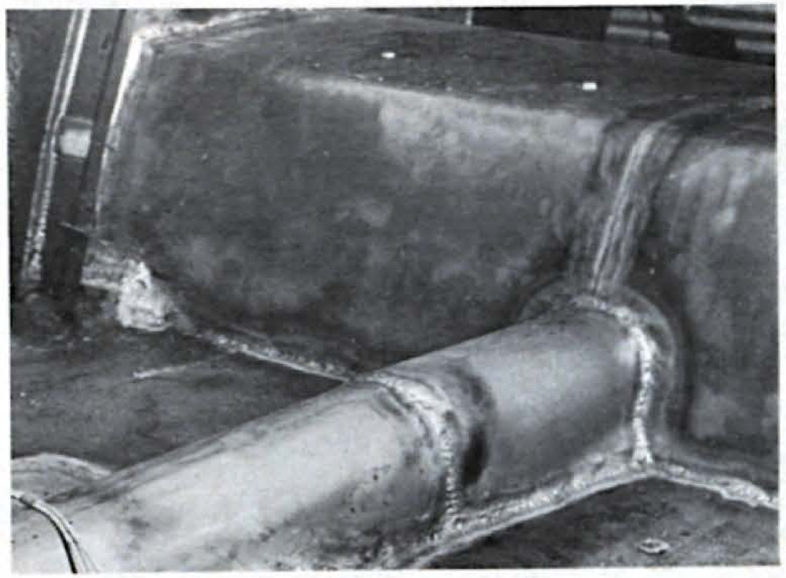
Step is welded over frame, existing frame cut away. Note new fender well that must be made for clearance.

New driveshaft tunnel must be made, as well as area over the rear end.

the rear crossmember is 'way too far forward. Chisel out the rivets, slide the crossmember back in the frame horns to the right position, and weld. Of the two methods of Z-ing we prefer the former.

"DOUBLE Z-ING

This is a step not overly common in rodding, but it sure is effective. Suppose a car is to be lowered drastically, but some semblance of clearance must be maintained at the front axle, engine pan, etc. A Z is put in the rear of the frame as described above, then a Z is placed in the frame in the vicinity of where the body firewall will be. This means that that area where the driver sits is way, way down. Usually, the rear is Z-ed about 9 inches and the front about 5 inches, or the width of



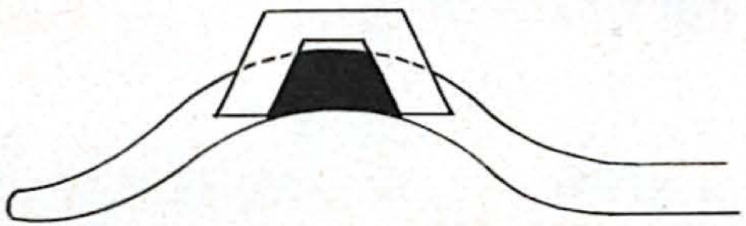
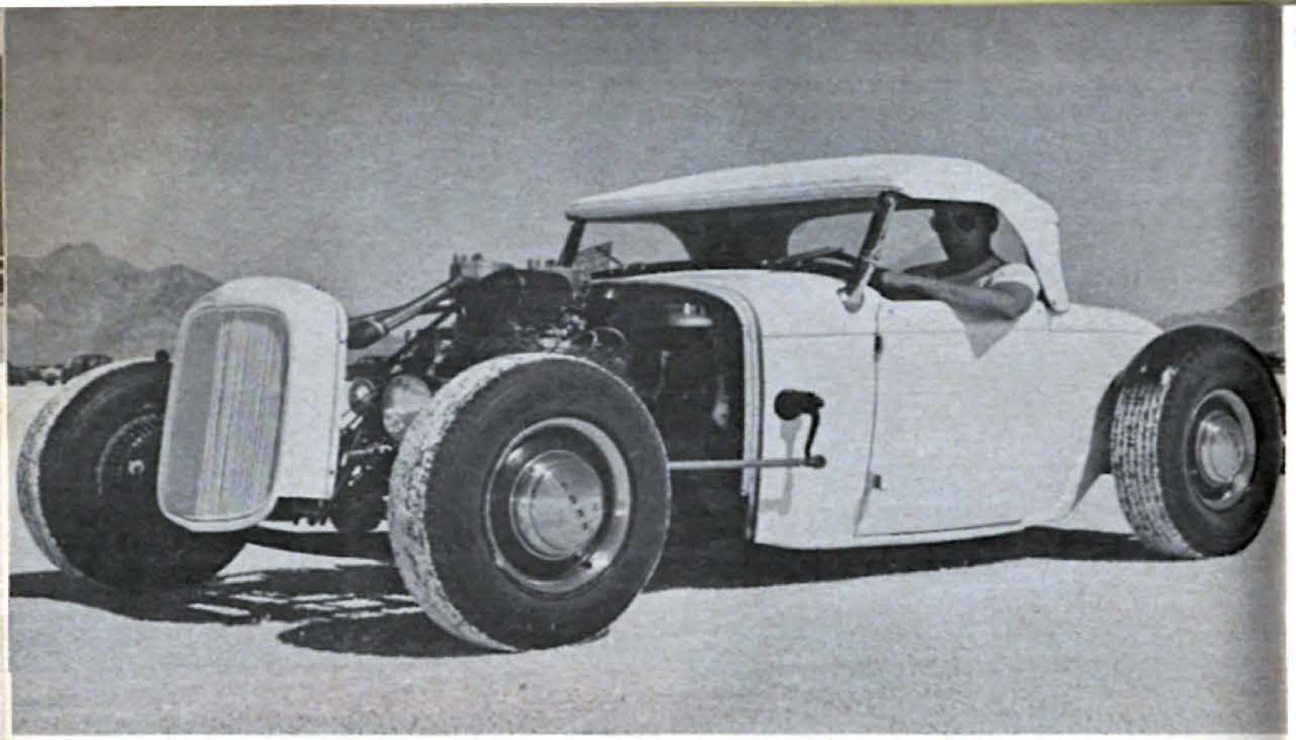


Illustration of stepped frame shows how the step is welded to existing frame, shaded portion is then cut out. Much clearance here.



This '32 Ford roadster rides extremely close to the ground due to a double frame kick and body channel. Front kick may be barely seen just ahead of the firewall.

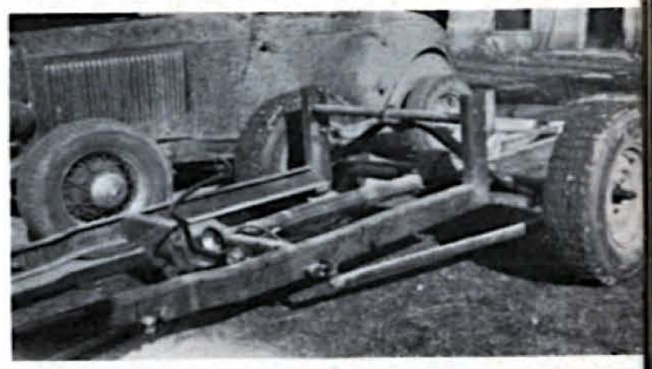
Hot Rod Magazine Associate Editor LeRoi Smith works on magazine project roadster that has frame made of 2 x 4 tubing. High kick will mount coil springs/shocks.

the frame. This way, the engine, transmission and rear end all sit high and dry. A high tunnel runs through the car, but it isn't too restrictive. Just imagine how low your roadster can be if it is kicked this way and channeled too. Plus, you retain good overall ground clearance and riding qualities.

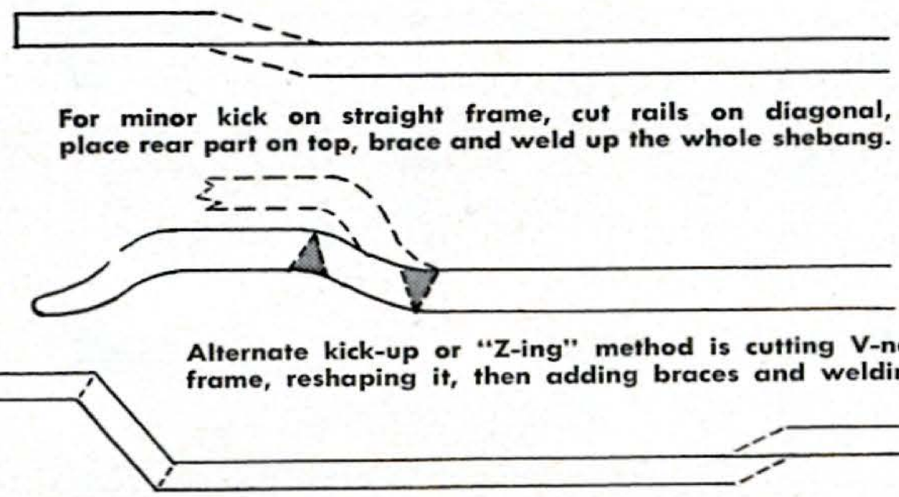
"BOXING"

Boxing of frames is easy, but is a most often overlooked phase of chassis construction. In essence, boxing is merely addition of a fourth side to a channel frame. It consists of cutting sheet stock (about ⅛-inch thick, normally) and fitting it to some area on the frame, welding, and grinding clean. In the old days, dragster frames were often made from Model T and A frames. The frames in stock condition were often too weak, so a fourth side (or inside) was added. To reduce weight, both sides were then drilled full of large holes. For our purposes, let's stay in the street rod category. Here the problem is that the frame is too weak to carry a big ohv engine and is sagging or twisting, or the frame rails have been cracked or broken. For that matter, maybe all these things are wrong.

The remedy is to cut steel to fit inside the rails from the front crossmember to the center crossmember (to the steering box on the left side, possibly). Weld it into position, and drill if you wish. You will now have a rectangular frame crossection. Boxing is the same no matter where on the frame it occurs, but the most common places are up front where the engine is and at the rear where C-ing, Z-ing, etc., might have taken place. ■



One way to get kick is merely to turn frame up, insert a tubing spring mount.



For minor kick on straight frame, cut rails on diagonal, place rear part on top, brace and weld up the whole shebang.

Alternate kick-up or "Z-ing" method is cutting V-notches in frame, reshaping it, then adding braces and welding it up.

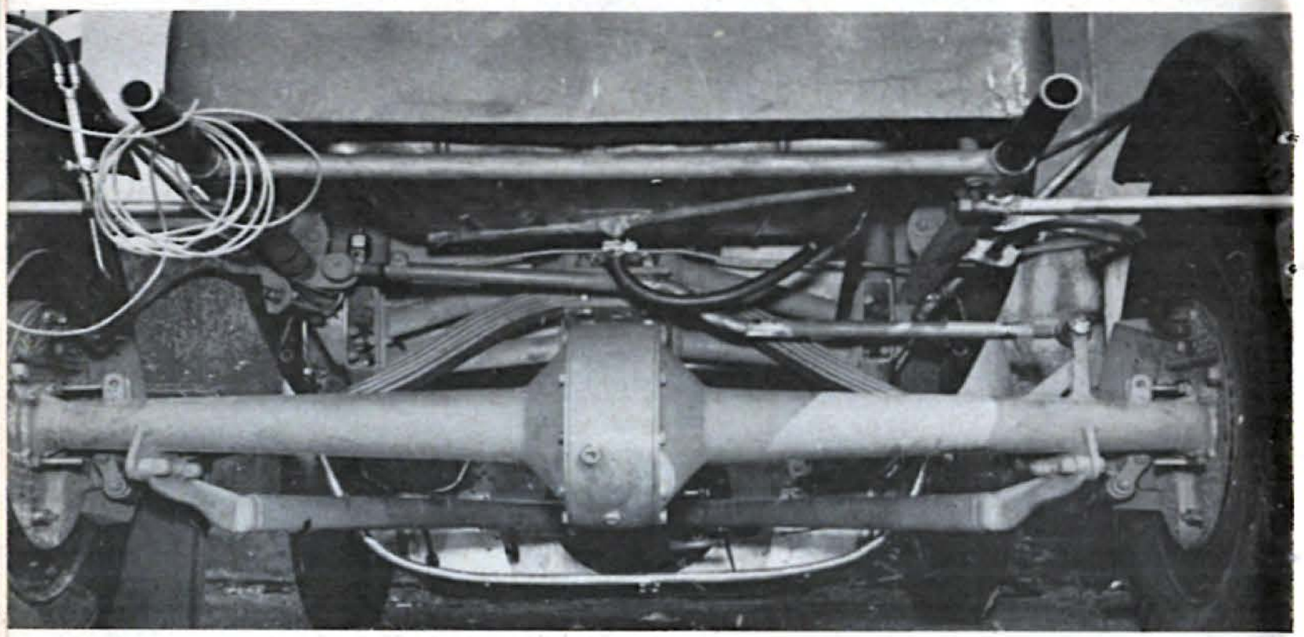
For double Z, use small kick method at front, add extra channel section for a high kick up at rear. Drop is extreme.

REAR ENDS

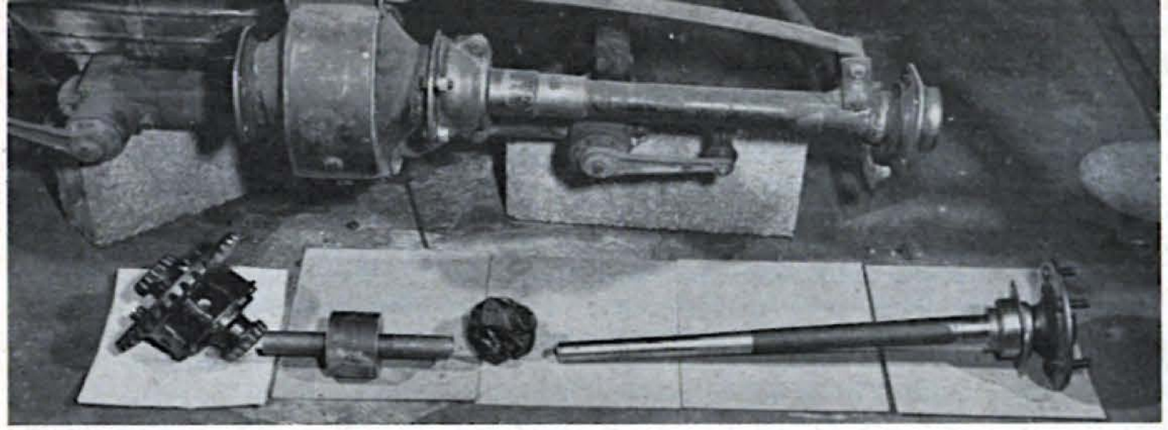
YOU may call it anything; differential, rear end, final drive, etc., but it serves one purpose—to deliver engine power to the road via wheels and tires. Such an accomplishment may be arrived at any number of ways, often somewhat strange and exotic. But here we will be primarily concerned with the more normal rear ends applied to standard hot rods. It would take a volume of considerable dimension to discuss theory and relevant possibilities that exist in final drive design.

Basically, in hot rod construction for on-the-street driving we must consider first what the rear end must do, and secondly how this shall be done. One might simply say that the differential assembly must put horsepower on the road. Right, to a degree. But we have a combination rod that has lots of performance so we want the best final drive unit we can get.

The old Model A rear end might be entirely adequate, if we are only using a stock or similar small horsepower engine. It might even be OK for a while with a bigger mill, but this is taking a chance. Installing a later model rear end is really very easy. Suppose the rod in question is an average 1932 Ford street job. It may have a small Chevy, or Dodge, or hopped flathead engine. It is necessary to install a better rear

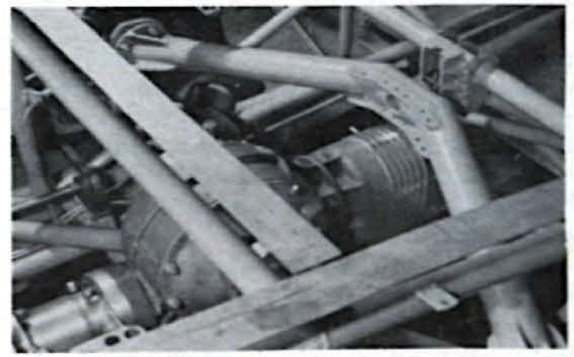


This early model Ford rear end has housings reversed to place 'A' spring in front. Radius rod brackets were relocated on housings, locater bar added to stop any sway.



Although a very difficult job, Ford rear ends may be reworked to become swing axles. A simpler solution is to check wrecking yards for swing axles from imported cars.

end with a minimum of effort. Simple, just do a bit of machine work on a '40 through '48 Ford or Merc rear end and install it. Besides, this gives hydraulic brakes on the rear. All that is needed here is to take the measured length of the original driveshaft and torque tube along with the new driveshaft and torque tube to a machinist. He'll cut and respline the replacement shaft and shorten the housing accordingly. All that remains is to shorten the radius rods, reassemble the newer unit and you'll be back on the road in no time. A couple of caution notes: the rear spring hangers on Fords vary according to year, so you must either relocate the hangers on the new rear end or move the spring. Relocating the hangers is the easiest way. Cars having open drivelines need only have the desired rear end located on the elliptic rear springs (a situation that might indicate the rear spring perches misalign. Just cut the perches off and move them) and a proper driveshaft fitted. While we're on this subject, be sure you have an open driveshaft modified the right way. Best method is to cut one end of the shaft right at the place where the original yoke and driveshaft tube join. Cut the shaft to the right length if necessary and install a yoke that matches the new rear end. The joint is



This modified Ford swing axle rear end uses a DeDion bar to locate wheels. Lateral movement is nil, but bar has limited movement in a vertical plane.

aligned, welded and, for best results, the driveshaft should then be balanced.

Perhaps the most common type of rear end conversion today is that of installing an open driveline rear end in the pre-'49 Fords. This is especially true on rods that do double duty on the street and at weekend drags. There are two methods accepted as most practical. The first is to retain the present Ford spring and to make new hangers for the open rear end. The hangers are usually made of heavy sheet steel, but in some cases hangers from Ford rear ends have been adapted. Just be sure all welds are strong. Some method of keeping the rear end from trying to "wrap" around its own axle center must

be incorporated. A set of radius rods (similar to original Ford items) may be made to connect between each side of the rear end and each frame rail. The front ends of these fabricated radius rods should be free to swivel, an ideal part being commercial or surplus Heim ends or stock automotive tie rod ends. It is also considered ideal if the forward ends of these rods intersect the frame rails of the car inline with the front universal joint. This is so the entire rear end and driveline swing in a constant arc, but much shorter units are in use everywhere. Many late model cars have formed steel radius rods that modify very well.

Another way of mounting the open rear end to a closed driveline car is to pirate the rear end *and* the original springs. When you're getting the semi-elliptic springs off a wrecked car, take the original spring mountings from the frame. Line the new open unit, springs and all, up under your rod and weld on the spring mountings. On cars such as the 1932-1934 Ford, the rear mount will be right near the end of the frame, or more accurately the frame horn. Of course, you can make your own mountings if you want. Should you desire to use a rear end that has springs too long, just pick up other springs that will fit and use. With this type of rear end set up, the Hotchkiss type rear end (the type you'll probably decide on) will want to "wrap." The cause is a natural torque reaction that occurs when power is applied to the final drive ring gear. As in the case of using the open driveline rear end with a stock transverse spring, the problem may be solved with some sort of stabilizing bar. Best bet if you're using the semi-elliptic springs is to install Traction Masters or the like. These are short bars that bolt between the axle spring perch and the front frame spring perch. They are free to move up and down, but resist axle twisting.

Of the two methods of mounting open type rear ends in older cars such as Ford, the latter seems to be gaining in popularity. We have ridden in conversions using both approaches, and the use of semi-elliptic springs definitely gives a superior riding and handling quality.

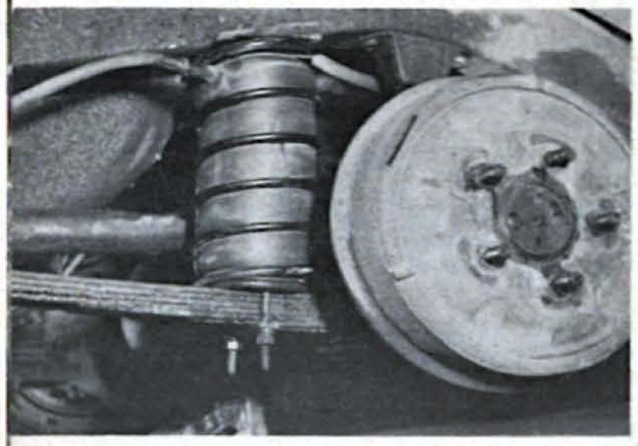
Maintenance on a rear end isn't overly difficult. If you have the normal amount of mechanical bent you may do most of your own repairs or modifications. But when it comes to working on the pinion gear, you might do well to leave that job to the professionals. Most pinions we know of have a specific "load" that should be set on them as they reside in the carrier. Just take your unit, or the component parts to a local mechanic and you'll know you're right.

If you want to install stronger gears or axles, just check with your local wrecking yard. They should have a catalog that lists parts interchangeability. As a guide, Oldsmobile rear ends of the early 50's seem to be high in rod building favor. They're strong, and you can get all kinds of interchangeable gears for maximum ratios.

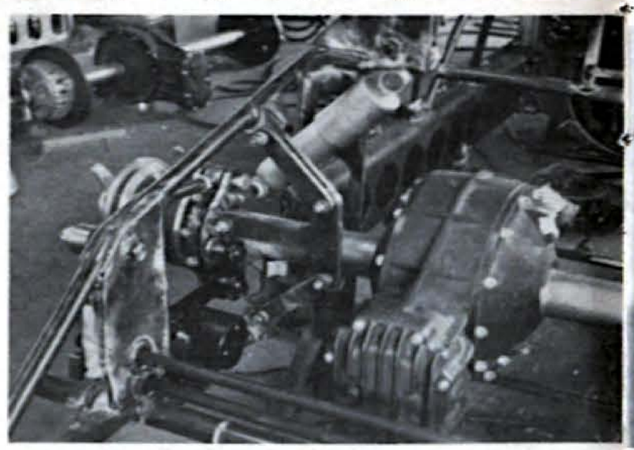
On the subject of gears, many rodders have trouble finding out what a car's gear ratio is with the rear end assembled (as in a wrecking yard). Merely rotate the hub one full turn while counting the revolutions of the driveline or pinion shaft. If the hub turns one full turn while the pinion shaft turns just a hair more than four times, then the ratio is pretty close to 4.11 to one, etc.

As to the limited-slip type of differentials, they are extremely popular and for several reasons. Basically, such a differential is designed to help maintain near constant traction between both rear wheels. If you've ever been stuck in mud or snow, you know the problem. The wheel meeting less resistance tends to spin wildly. With the limited-slip rear end, when one wheel tries to spin, it can't, thus you get equal or near equal tractive force. For drag racing this extra traction is highly desirable. For general street driving in any kind of inclement weather, it can't be beat. This is the nearest thing to a locked rear end, but the differential still allows the car to negotiate corners properly. As to a locked rear end for the street, one word will suffice—don't. Limited-slip type differentials are available from a number of manufacturers, some being designed for normal street use while others cater more to heavier equipment getting rough usage, such as pickups, etc.

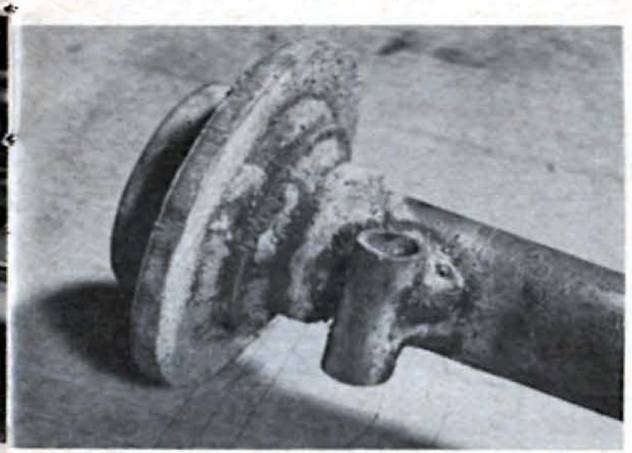
Selecting and installing the rear end of your choice is pretty much of a personal thing, since nearly every application is different. We've passed along the general information on the two types of rear ends in common use and the most popular methods of utilizing them. Here again, you can save lots of time and headaches if you'll just consider the job requirements of your rod, what the replacement item should and is capable of doing, and plan the installation beforehand. ■



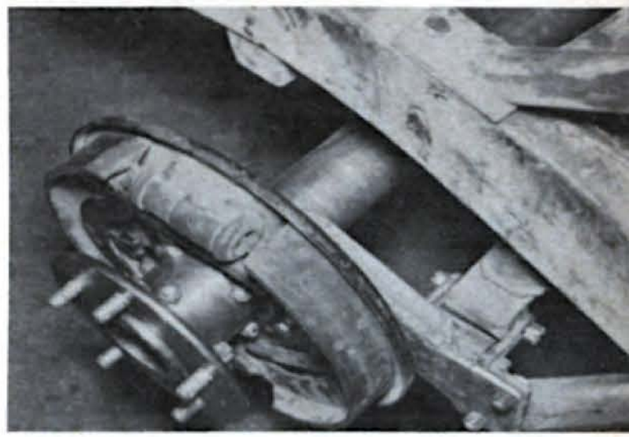
Air bags with small locating coils are becoming popular method of suspension on rods using late-model rear ends but not having room for semi-elliptic springs.



A modern race car suspension using parallel leading arms on rear end, torsion bars, and W link to control side sway. Both Houdaille and tube shocks are used.



Simple rear end spring perch is piece of tubing welded to rear end housings. They will accept the Ford shackle bolts. Make sure that all arc welds are very strong.



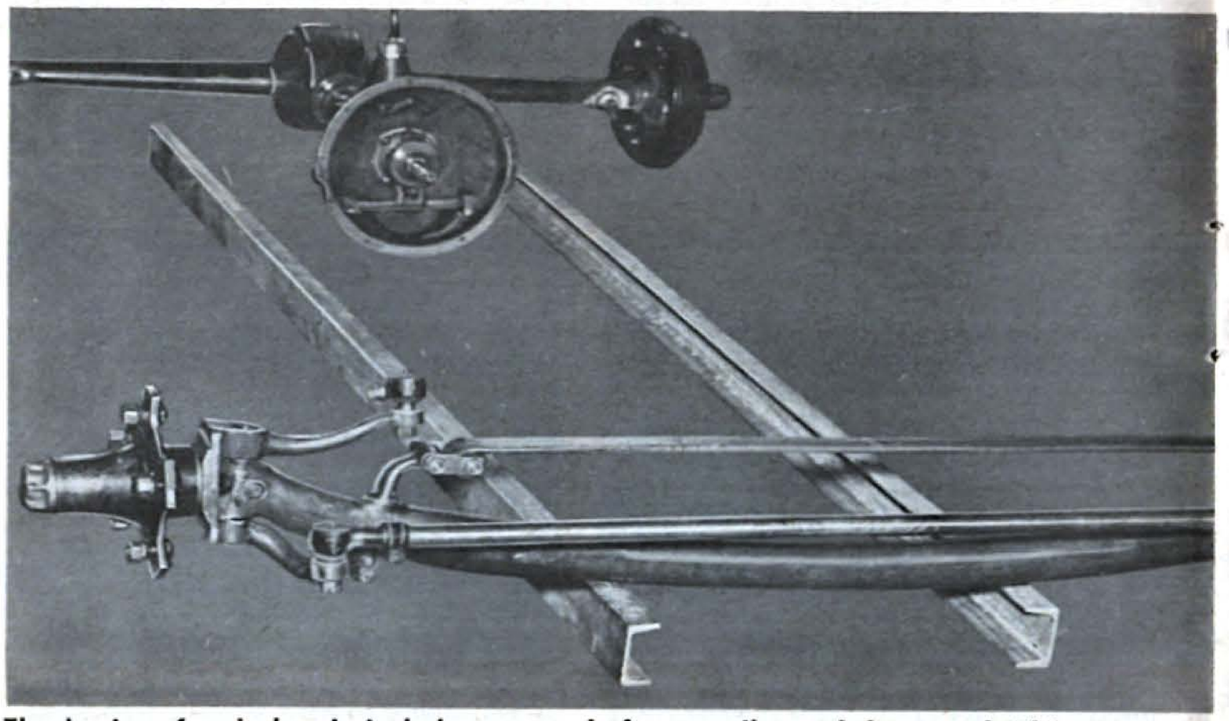
These housings were reversed to place spring ahead of axle, plate added alongside hangers to hold the modified radius rods. Tube axles are featured here.

FRONT ENDS

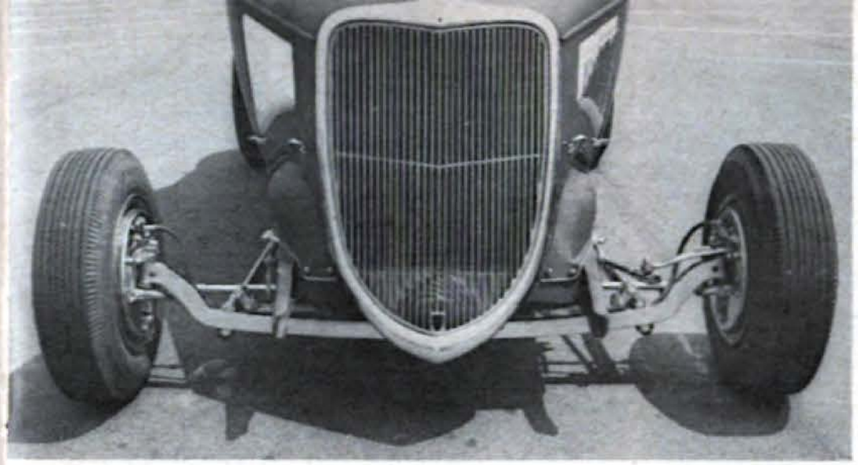
GENERALLY speaking, it might be said that the front end of an automobile supports that end of the vehicle and provides some means of directional control. This is a rather basic explanation, but that is, in essence, what the front end does.

In the search for plausible front end systems applicable to hot rod design and construction, only two designs are finding widespread use; the solid axle and the trailing link systems. Exploring this subject casually, you will discover that there are two types of the solid axle. The Elliot axle is the standard beam unit used in many older cars and some present-day heavy duty vehicles. It is nothing more than a beam or solid axle having each end opened to form a type of squared off C. The steering knuckles fit into this C and are positioned by kingpins. The type of solid axle most familiar to rodders is the Reverse Elliot. This type features steering knuckles with yokes that fit over the axle ends. The pre-'49 Ford axles were Reverse Elliot types. There are no appreciable differences in values or performances between the two types.

The most common axle found in hot rodding—in fact, almost a rodding tradition—is the solid beam type. We say solid here to differentiate between tubular and beam units. The original equipment axles found on early Fords are beam, except for a very few tubular



The basics of rod chassis include rear end, frame rails, and front end. This competition front end has spindles reversed on Ford tubular axle, brake drums cut away.

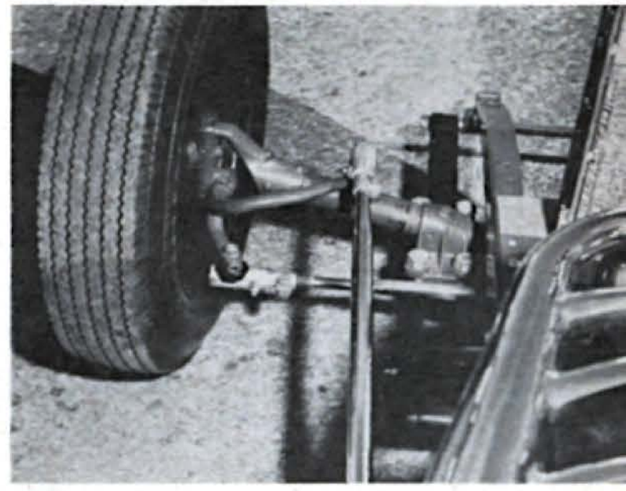


Unusual dropped axle has been filled clear across its length, gives good appearance.

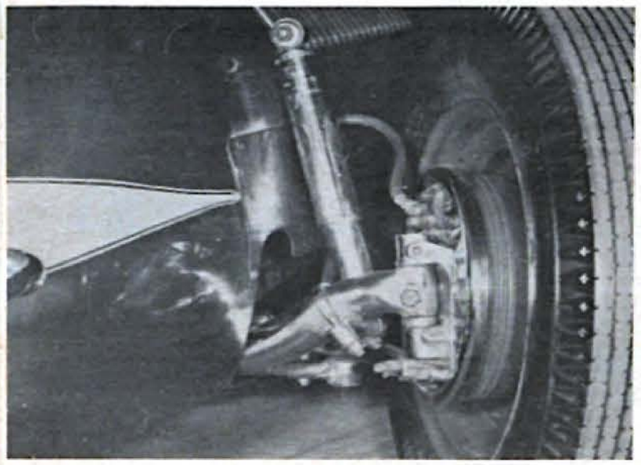
units produced for V8 60 equipped cars in the late 30's. The very simplicity of the Ford chassis has made it a rodding favorite for years on end. The same reason applies to the widespread use of Ford solid axle front ends. They are easy to modify, inexpensive and parts are readily available.

As discussed in the chapter on frames, the choice of frames or frame modifications will dictate to some extent what type of solid axle will be used. Since most special straight tube and lightweight tube axles are manufactured solely for competition use, we will here assume that the axle chosen will be of some standard automotive make. If the car in question happens to be a 1934 or older Ford, then an axle having the spring mounted directly above will probably be necessary. If this is the case, there are several approaches to use. If the car is to be of the restored variety, the original front end will probably be sufficient. If it is a rod with an accompanying heavier engine and hydraulic brakes, several deviations are in order. If the car is a Model A, but a very slight drop is desired along with a huskier axle, we suggest using a 1932-1934 Ford unit. If the car is any Ford up to the year 1935 and a major front end drop is desirable, special dropped axles are available from speed shops. A dropped axle merely has had that portion of the axle between the ends and the spring perch bolts reshaped to allow the spindles to ride higher than they normally did. Drops of 2½ and 3½ inches are common.

Dropped axles are also available for 1935 through 1948 Ford products. These axles feature spring perch bolts located a bit further toward the ends of the axle than the pre-'35 units. This means that a more severe bend (or S shape) must be put in the axle ends to attain a drop common with the earlier axles. The tighter bend usually



This rod uses frame having semi-elliptic front springs, an Elliot type axle. Though rather rare, these suspensions work out quite well on rods and give good ride.



Front axle and spindle/hub assembly from a 1939 Dodge was used for this special rod. Such units are common, work out very well indeed.

means that some portion of the spindle steering arm will hit the axle. Only solution here is to heat and reshape the steering arm on both spindles until they do not have such a lazy bend toward the rear. By heating and bending them in nearly flush against the backing plate, they will clear the axle. Be sure and align the arms properly after they're modified, or you may run into some steering problems. It isn't advisable to cut and weld any portion of the front end. This is for real professionals who know their business.

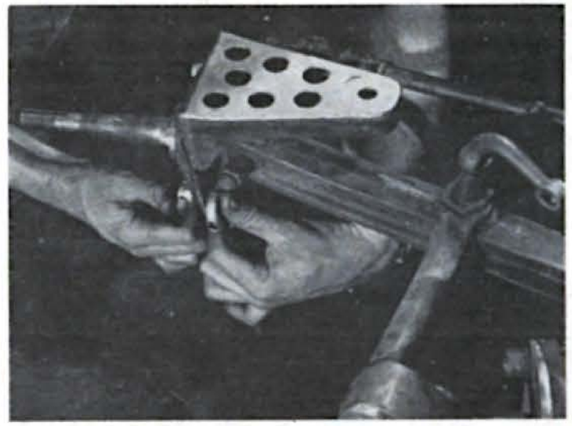
We won't touch on brakes just yet, but if you desire hydraulic brakes, the same procedure applies whether you're using a dropped axle or not. Ford did not put hydraulics on their cars until 1939. This means that everything up until that time had mechanical stoppers. That is, the means of placing the brake shoe into contact with the drum was by mechanical linkage from the brake pedal to the brake shoe.

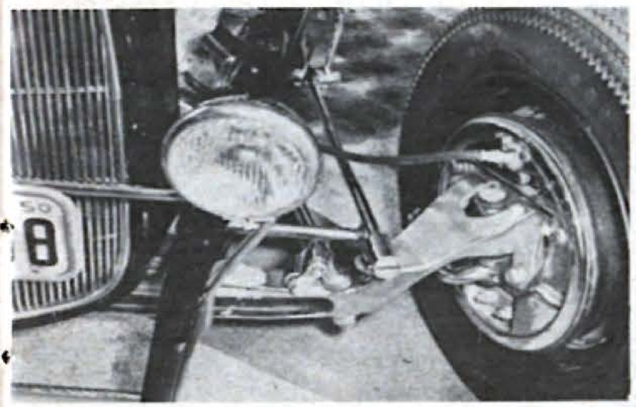
If you have a Ford front end that you want to use (that has mechanical brakes) and want to install hydraulics, but don't know what year the front end is, follow this pattern. If the spring is ahead of the axle, then it is for a Ford '35 through '38. If this is the type of unit you're using, then the backing plates and drums from a '39 through '48 Ford should fit directly on the spindles. If the spring is above the axle, then you'll probably have to purchase a special hydraulic brake installation kit from a speed emporium. Fitting hydraulics on the Model A axle (where you want to retain the Model A spindles) will mean the use of spacer rings between the new backing plates and where their counterparts formerly mounted. That is, the large center locating hole in hydraulic backing plates is larger than those on mechanical units, thus the spacers. The backing plate mounting holes won't align, so a little enlarging with a rat-tail file is in order. To use the later hydraulic type brake drums a small sleeve must be slipped on the spindle bolt to locate the wheel hub's inner bearing.

The easiest and possibly best way to get hydraulic brakes on the older Fords is to use the entire spindle set up from post-'39 Fords. Incidentally, it has been noted that many rodders have been mounting the spindle thrust bearing incorrectly. This is a round bearing that fits between the bottoms of the spindle and the axle. The kingpin locates it. This is there so that steering isn't such a bind in troublesome spots. But, some rodders, especially on dropped axle installations, have moved this bearing to a position between the top of the axle and the top spindle yoke. Here it does nothing more than take up space, although it does give a bit more drop to the front end.

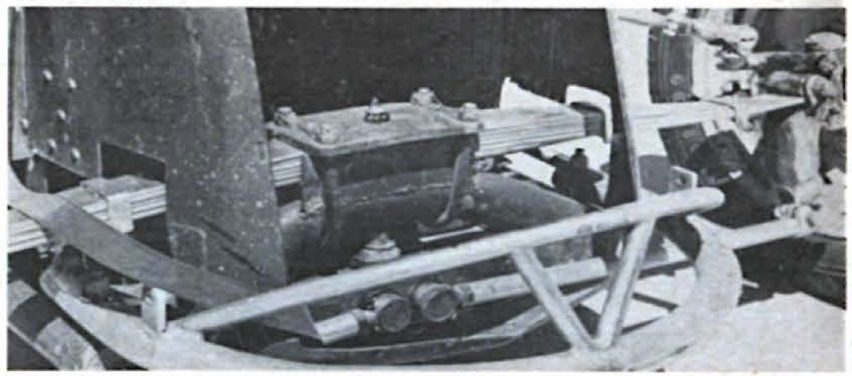
If '39 or later spindles have been used up front, then there is no steering arm on the left front wheel to connect to the drag link. You can make such a unit simply, but for a very minor cost you can purchase one from the speed shop.

Should you desire to split and remount the radius rods (wishbone) on your front end, it's quite simple. Cut the solid C-shaped connection from the wishbone at the rear, swing the ends out to the frame. Weld tie rod fittings into the ends, making both rods equal length. Determine the height of the previous frame mounting from the ground. Construct new plates of sheet steel to either bolt or weld

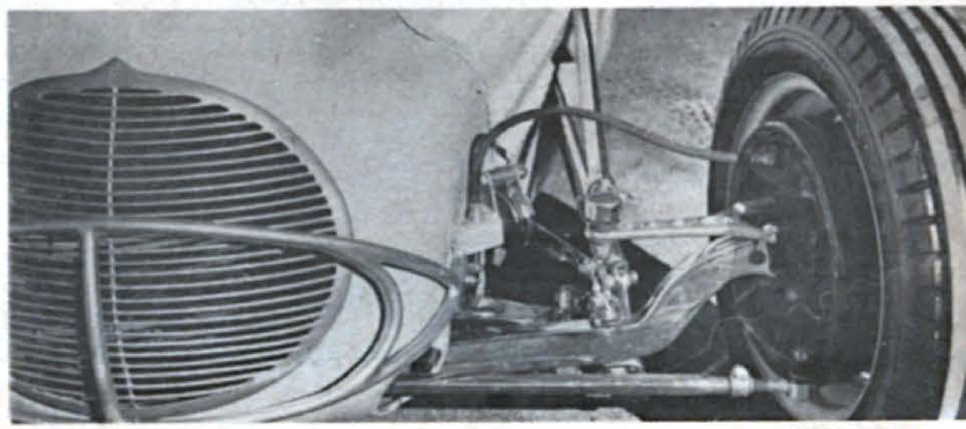




ABOVE—When mounting post '35 Ford spindles on earlier axles, steering arms must be made, such as this one. LEFT—Speed shops usually have steering arms available, the type shown here was popular in late '40's. BELOW—Specially made steering arm on a track roadster.



Unusual front end on early lakes rod had spring mounting above two locater bars. Idea is remotely similar to Studebaker front suspensions of the 1930-40 era.



to the frame. These plates should be ¼-inch thick or thicker. They are located on the frame at the ends of the radius rods. Holes for the tapered tie rod ends are then drilled in the plates, the holes being the same height from the ground as the original mounting. Tie rod ends are then screwed in the radius rods and bolted to the new frame mounting plates. In some instances, holes may be drilled directly into the frame, no plate being needed. Remember that the caster of the front end is affected by where the ends of the radius rods are located. Close to the ground is lots of caster, higher up is less, etc.

You might have seen beam or tubular axles under rods that don't exactly look like the more common unit. Quite possible. Many of the dropped axles have the outer ends, or dropped section, filled and smoothed. That is, the ends look flat quite unlike an I beam. You may have seen some dropped axles with a tubular center part between the spring perches and filled ends. These were originally built and marketed by Cragar, but the patterns have long since been sold. As far as we know these axles are no longer available. Dropped tubular axles are rather common. Usually these are items from the aforementioned Ford V8-60 cars or trucks that have had the ends heated and dropped as with the I beam axles. Because of construction problems, these axles are dropped less than the beams. In some rare cases, rodders have built special tubular axles with drops that look like the original. Mostly, however, the tube axles that are handmade are either straight or incorporate a straight angle at the ends for the drop, rather than a tight S shape. Such axles are most prominent on drag cars.

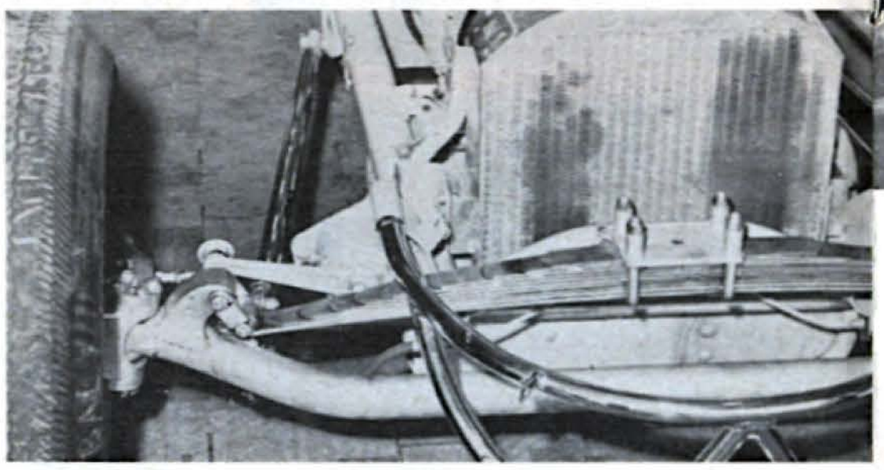
If you have a tubular or beam axle and wish to mount it *ahead* of the spring like many builders of late, follow this procedure. Get the complete wishbone set-up from a 1935 or later Ford. These front ends mount the spring ahead of the axle, the spring perches being incorporated into the front ends of the wishbone. Saw the wishbone off just behind the place where it bolts to the axle (about 3 inches). Turn the two stubs around, switch sides and bolt them to your axle. The spring perches, or we might call them hangars, are now behind the axle. Fill and smooth the cut off ends which now stick out front. Of course, you'll have to build split radius rods, but a look at some of the photos in this book will show how simple this procedure is.

If you're looking for a really kookie tube front axle, you might consider using the one out from under a Chrysler product of the very late 1930's. These axles have semi-elliptic springs and a good drop at the ends. They also have a flat forward bend in the middle that is of little consequence on a rod other than appearance. Ream the ends of this axle for the Ford spindles and kingpins if you want to, or use the hydraulic brakes and hubs with the axle. Get some spring perch bolts from a '34 or older Ford, locate and weld onto the axle. That's it. An unusual axle, especially for a show/street rod and they are really easy to find.

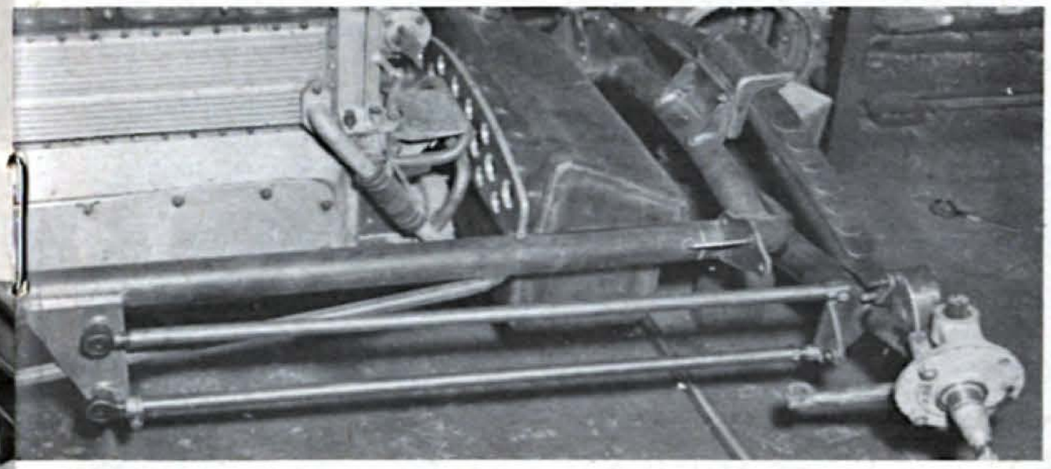
This about covers the solid front ends most commonly found under rods. Only a few reminders. Make sure all places where pieces join in the front end are tight. Have the front end aligned and the solid axle straightened if need be. Make sure the kingpins and bushings are in good shape. If they aren't, you'll probably experience much front end "wobble," especially on rough roads.

The other type of front suspension normally found on cars is the independent type. There are three basic types in this grouping in common use; wishbone arm, trailing link, and sliding pillar. Of these three, the one finding most favor at present is the trailing link. Specifically, this is the Volkswagen-Porsche unit so easily adaptable to rods. We'll cover this thoroughly in a later chapter.

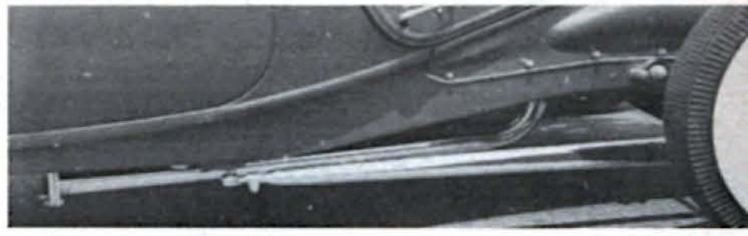
The wishbone front end is seen occasionally on a rod, but not often. Its primary drawback as far as rod use seems to be appearance. Independent suspension is designed to hold the front wheels in one of two ways, but not both; so they always are parallel to the vertical plane of the car, or so they always track. The trailing link front end does the former, the wishbone arm does the latter. In wishbone arm design, the upper arm is normally considerably shorter than the bottom. This allows the outer ends of the two arms to move in different arcs, thus allowing the tread width of the vehicle to remain relatively constant. On a severe turn where the car leans, these characteristics cause the outboard wheel to bank against the turn. This puts the



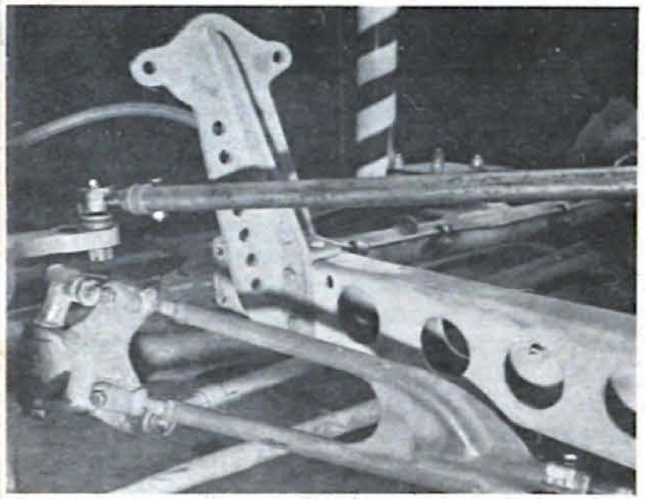
This is a specially built tube front axle for a track car. Long springs are used to take advantage of max. deflection.



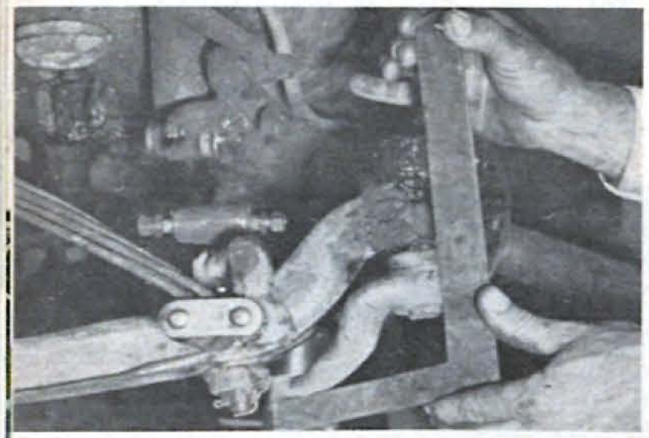
Tube front axle on this race car is located by individual radius rods, making caster adjustment easy. Note shock mounting plate.



This '34 Ford has split radius rods mounted beneath frame.



Boxed and drilled 'A' frame uses special radius rods to locate tube axle. High towers will mount lever type shocks.



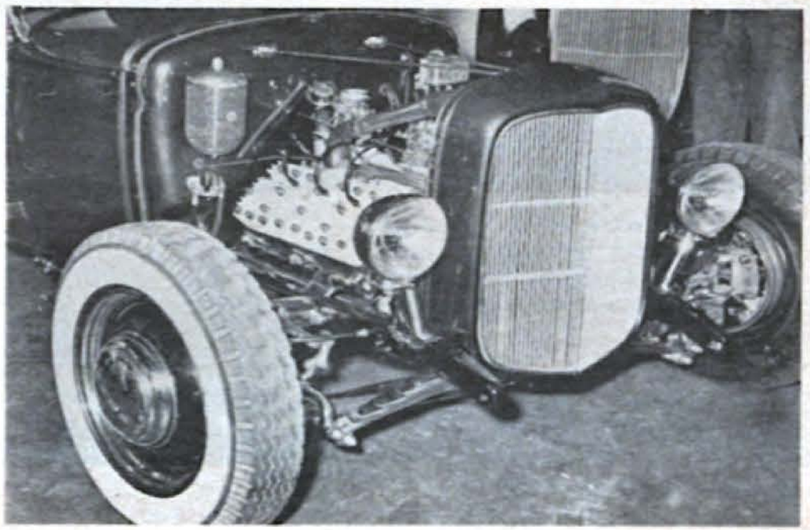
best traction at the point of greatest load.

We will be concerned with incorporating an available wishbone arm suspension in our car, so we won't go into further technical detail. The American car usually has a high degree of safety built into its front end. This, plus production methods, means the average American wishbone arm suspension is rather bulky. When placed in this state on a fenderless rod, the finished product looks nose heavy. But when used under a fendered car, the unit is almost imperceptible.

Basically there are two ways of mounting this type of front end suspension under an older car such as a Ford or Chevy. The first method is to use a front end that is not too bulky, such as the '40 Chevy, and that will bolt or weld directly under the existing frame rails and front crossmember. If this is done, interference of the upper A arm and the fender is usually nil. But now the rod sits too high in front. A set of modified and dropped spindles from a speed shop will cure this problem.

Second method used is to weld the

To put dropped axle on post '35 Fords, the spindle steering arm will have to be bent in and down to clear axle.

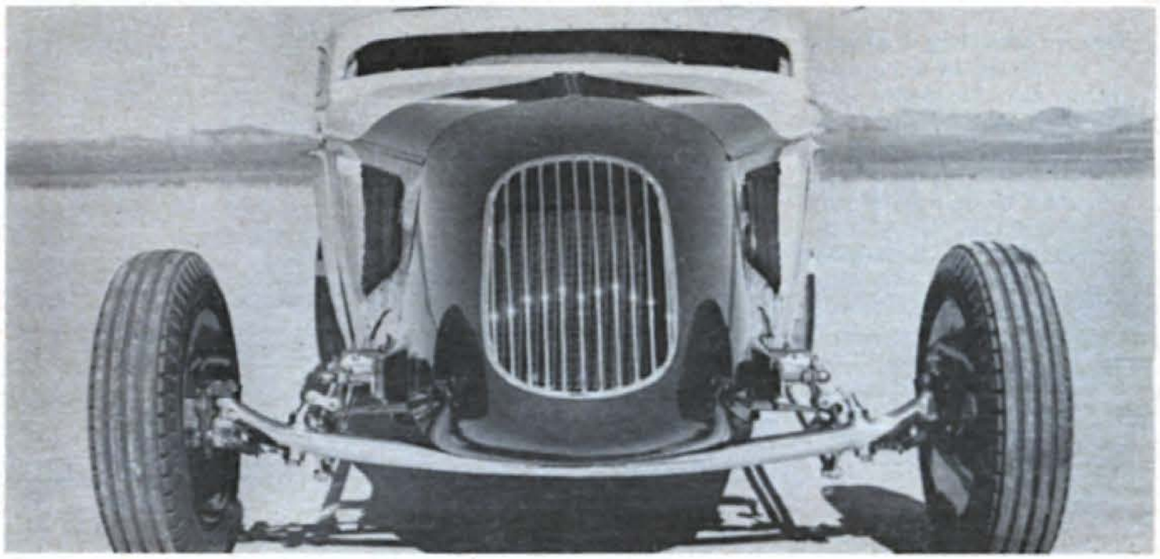


Channeled 'A' uses Ford front end of type mounting spring ahead of the axle. Spring must be mounted to frame ahead of crossmember, otherwise wheelbase is short.

older frame directly to the wishbone front crossmember. For instance, suppose a later model wishbone front end with ball joints is used, such as a Ford or Chevy. Merely cut off the front of the frame so that the wheels of the new front end are in the position occupied by the former wheels. Weld the old frame directly to the new front end crossmember and add appropriate strengthening gussets. Use the late model steering gear completely. Some work is necessary in this installation to provide mounting for the old fenders. Brackets will handle this, along with a portion of the old frame horns. A bit of minor work will probably be necessary on the fenders to get them to clear the area where the upper A arm mounts to the crossmember.

We have an acquaintance who built a '32 Vicky up for family use. One of his first requirements was that the car had to handle and ride as good as a late model car. A big order, but he accomplished the feat by installing the complete rear end (including springs), engine and front end from a wrecked '55 Chevy under his Ford. Only the very experienced eye could detect any outward evidence of the modified chassis, but anyone could tell you how great the car handled and rode. It was as a new car, with excellent comfort coupled to near sports car roadability. And it took very little time for the entire job to be accomplished.

Now that you have an appropriate front end under your rod, you're ready to *start* the front end work. You're all finished, you say? Well, not really. That front end assembly must be checked and aligned at your local front end specialist. Of course you can do a great deal along this line by making sure that the front wheels are at least in the general vicinity of where they should be. This by using an ordinary tape measure to check wheelbase on each side of the car, the distance between the front of the front wheels and the distance between the rear of the front wheels, etc. But don't neglect to get the assembly aligned. You're in for some mighty big headaches if you don't. This goes for the solid front axles too, since they can certainly be out of kilter. ■

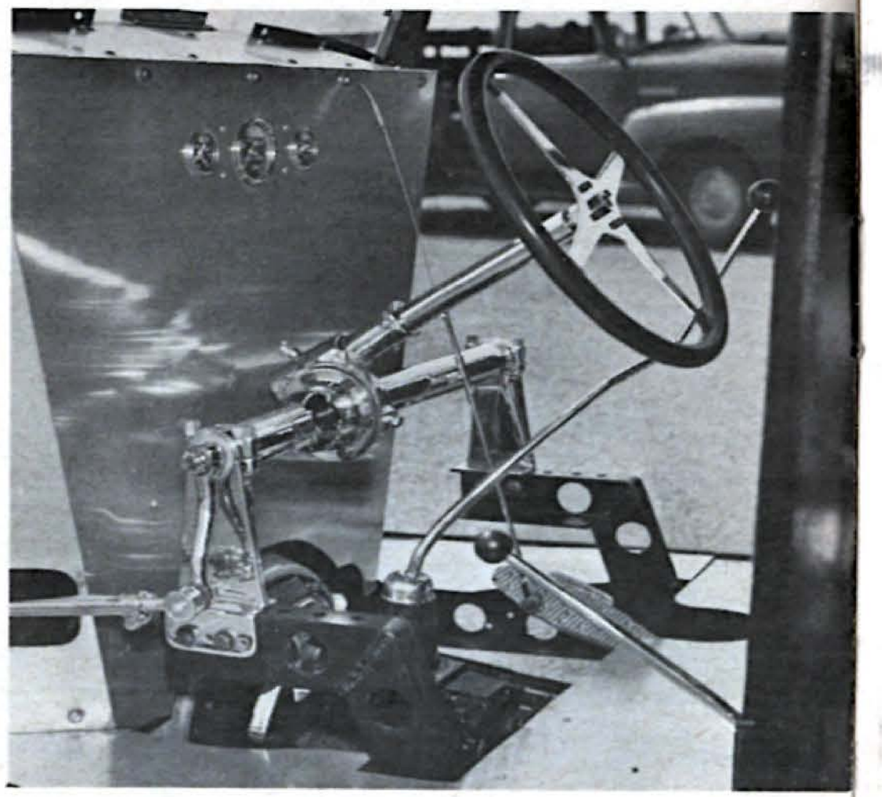


Some Fords of the late 1930's (V8-60) had tubular axles like this one used on a Bonneville coupe. These axles may be dropped, but only about 1¾ inches total.

STEERING

RIGHT off the bat, we may assume that this problem of steering as applied to hot rodding will affect very few. In fact, only those rodders building up an older car will normally have need to modernize their steering. We are not going to go into the technical details of proper front end alignment for good steering. Instead, we shall contain in these pages only the very practical information necessary to make the traditional rod handle better. So we can do that job more thoroughly, let's dispense with steering problems on the late model cars quickly.

First, all new cars steer good, or reasonably so. Thus, no real problem there. If the owner merely wants a faster steering ratio in his new car, then he should consider getting a car with power steering. The power units usually have a ratio approximately 25 percent faster than conventional jobs. If the situation arises from an engine conversion, the problem is usually the tie rod connecting the two front wheels. Speed shops carry modified items just for this purpose. Actually, an engine conversion is accomplished easier if a pre-fabricated adapter kit is used and a dropped tie rod is usually included in such a kit. Another method of clearing the tie rod is to use specially fabricated steering arms having more drop in them than the stock items. The September 1956 issue of Hot Rod Magazine carried a thorough run-down on this procedure. Only other occasional problem encountered in steering during a late model engine swap is location of

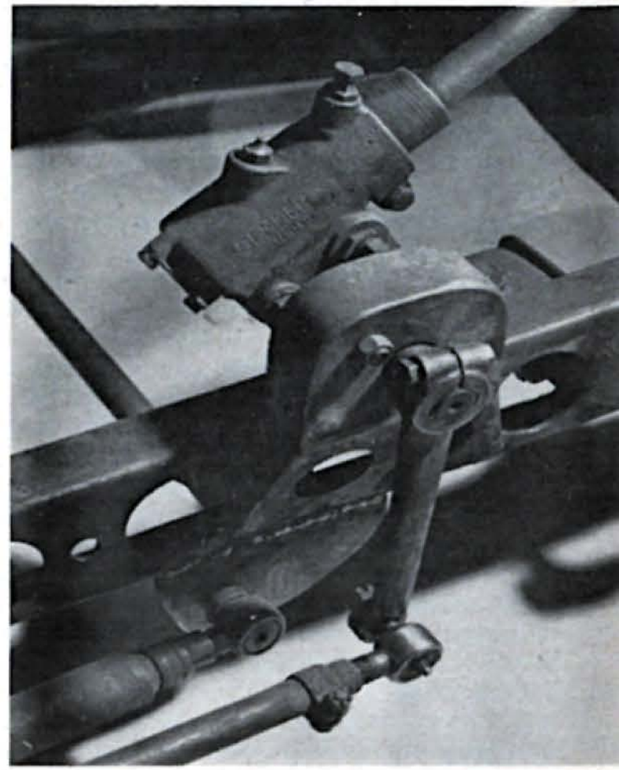


Center steering is almost a requisite of a competition car. To make such a unit, the sector shaft and housing must be lengthened, similar tube added to opposite side of gear box for mounting purposes. Special center steering gear boxes are now available at speed shops.

the steering box. This is usually just a case of clearance which may be cured by special headers, starter motor relocation, etc. Along this line, we might mention one solution that comes to mind. A friend recently installed a 1955 Buick V-8 engine in his decidedly stock '47 Ford sedan. Virtually everything fit but the starter touched the steering gear box. The rivets holding the gear box mount to the frame were chiseled off, the mount slid forward 1¾-inch, and bolted and welded back to the frame. The starter was thus cleared. Note that this was a very slight movement, and possible because of the use of a transverse drag link on pre-'49 Ford products. The steering wasn't affected. However, our friend wanted faster steering, so he exchanged his '47 pitman arm with an earlier model having a shorter length. The ratio was bettered and steering feel wasn't noticeably heavier.

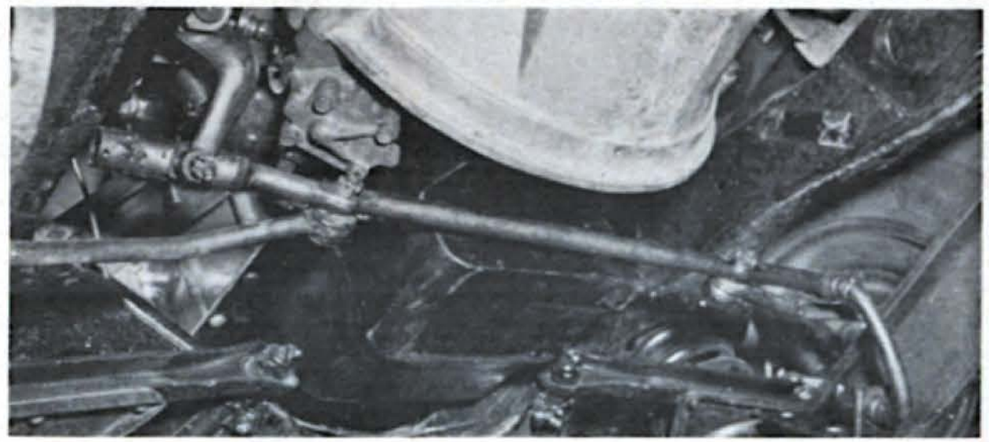
But now let's talk about the steering problems that are likely to crop up when building a rod. And we mean the traditional kind of rod, so we'll qualify our words here to mean anything on a 1934 or older Ford or similar car using a drag link parallel to the frame rail.

Starting with a car that has been fixed up only to the extent of restoration, good steering is still something to con-



Model A frame with a Model A steering box specially mounted. This will clear headers and the like, a common practice.

Engine swaps in late model cars usually mean a steering modification. Rather than change the tie rod, this builder modified the rear portion of the engine pan.



sider. Anyone having spent some time behind the wheel of a Model T, Model A, or other car of that era knows what bears they were to herd down the road. This was especially true if the steering was worn a bit, tires were low, bushing dry of grease, etc. Oh, we'll be the first to agree that if a restored car is to be perfectly stock, it should retain stock steering. But if any modification is to be considered at all, steering should rate high on the list.

During the late 49's when nearly every rodder had some kind of pre-'35 car, it was very popular to utilize the '34 Ford steering gear box. This box would fit into a Model A and '32 frame easy and retained the very fast steering ratio deemed desirable. That is not to say that rebuilt Model A or '32 boxes weren't used. Along about 1950 several rods showed up using modified post-'35 Ford steering adapted in one of two ways.

A very popular way to use the transverse drag link steering arrangement from a later car was to mount the new steering gear box normally in the rod chassis. This meant building a mount on the inside of the frame rail about halfway between the firewall and the front crossmember. Thus the gearbox mounted in its usual position with the sector shaft pointing down toward the ground. The pitman arm swung horizontally and connected to the right front steering arm by a drag link. The pre-'41 Ford gear boxes were usually chosen because of their faster action. Only trouble here was that the older frames had not been designed for this kind of steering gear mounting. So the frame rail holding the gear box tended to flex when the steering wheel was turned. Boxing the inner part of the frame helped some.

A more common method of using this type of gear box was to turn it on the side with the sector shaft sticking through the frame as the original steering did. The mounting holes on the new gear box were then facing upward. A plate placed horizontally on the top of the frame could be built to mount the steering. This type of mounting was advantageous from another standpoint. The pitman arm could be rotated 90 degrees on the sector and would then point straight up. The normal steering had the arm pointing down. This variation really proved its worth when the car in question happened to have a dropped front axle. The steering arm on the front end and the stock pitman arm were far from the same height off the ground. Therefore many rods ran around with the pitman arm climbing toward the front end at a steep angle. (For that matter, lots of present day rods have the same feature.) Using the post-'35 Ford steering turned sideways eliminates the drag link problem. Since the pitman arm points up, the drag link sets in an almost horizontal position.

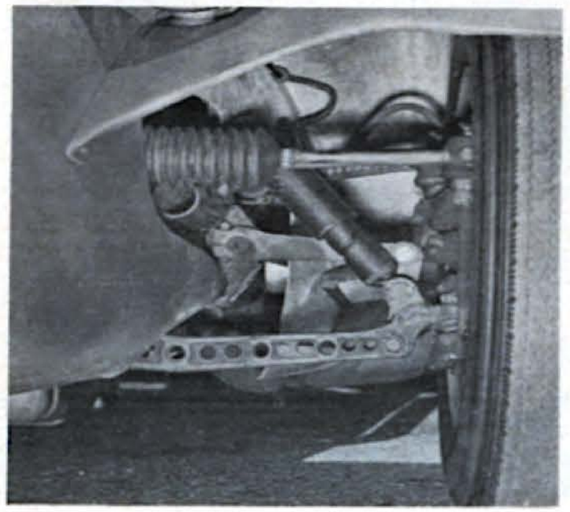
During the process of building a rod, every enthusiast has contemplated the steering. For this reason, there have been untold approaches used. Suffice it to say that several gear boxes will fit the older frames. Any steering that features a parallel drag link can be modified to work. Often this means minor or extensive frame modification around the box, or mounting the steering box above or below the frame. All are quite simple. There are some cases even, such as pre-war Willys and Hudson units, that will nearly bolt right into existing frame holes. The best criterion to follow when selecting a steering is to get one that suits your particular driving habits, will work well on the car, and is relatively simple to install.

Perhaps the most common type of steering found on present-day rods is the pickup. Since the very late 40's many pickups have been using a good parallel drag link steering that is easily adaptable to older cars. Of these, the '54 and later Ford and Chevy items seem to be highest in demand. Either of these units sells complete in a junk yard for around $15 and requires little modification to install. Of the two, the Chevy fits easiest. Mounting bolt pattern on the Chevy (or GMC) allows it to be set into a Model A or later Ford frame with minor trimming around the edges. Use the stock Chevy pitman arm and modify your drag link to fit. The Ford box will need the edges near the three mounting holes ground off to fit into the '32 through '34 frames. On Model A's some small frame work is needed. Your existing drag link will fit the late Ford pickup pitman arm.

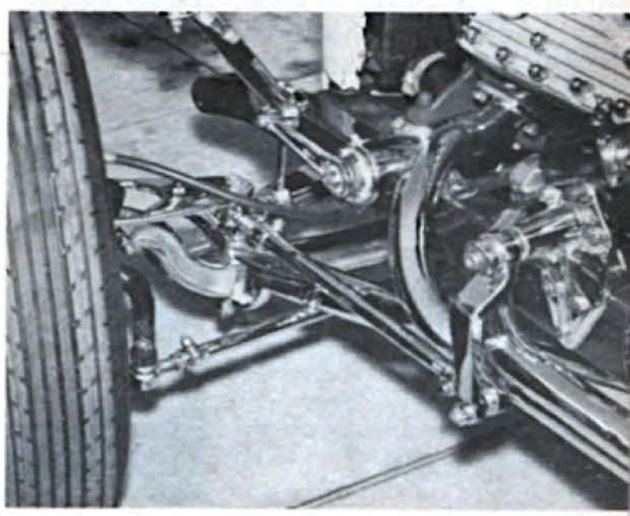
Builders of rods using Model T or similar frames and bodies are also using these pickup steering boxes. They put the column through the floorboard in the manner of the original and build mounts for the gear box. The pitman arm is then modified to point straight down, and they are in business. Also, this was a sneaky way for us to get into the subject of modifying pitman arms. It is best not to modify them. A little searching will usually turn up the right arm that will fit. In case it doesn't, here are some hints on building one. First, assume that the best thing is never to use a modified stock arm. Use a specially built one instead. Select a piece of good steel ½-inch thick or so. Flame cut a new arm out and bend it to the proper shape to clear the frame, etc. Have the upper end drilled and splined to fit the sector shaft. The other end is drilled and tapered to take the drag link connection. Two or three holes may be drilled in the bottom end so some type of steering ratio adjustment is available. If it isn't feasible or easy to get the sector hole splined, just cut a big enough hole in the top end to take the splined area from the original arm. Weld this section in good, and you're off. A magnaflux of any welded areas would be apropos.

As we've said, this story of steering could go on and on, so it's strictly up to you to do some nosing around and suit your own individual needs. The best place to start is the wrecking yard. Incidentally, you may want to install turn signals on your car. If the late model pickup steering is used, the upper end of the column housing will probably have provisions for a turn signal control. Then too, such a housing may be modified to fit your existing steering so you can get turn indicators that way. ■

This sports car special has independent front suspension, torsion bar springing, and a rack and pinion steering gear.

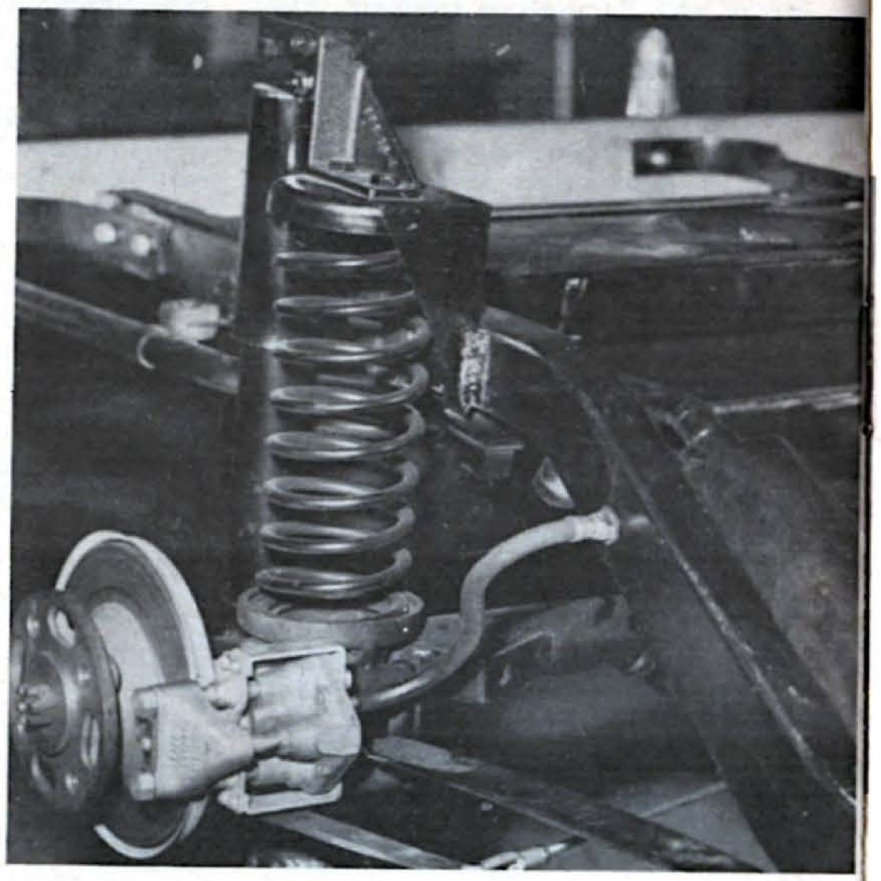


More common on rods is modified stock steering. Here sector shaft has been lengthened to give pitman arm clearance.



SHOCKS and SPRINGS

AS WITH everything, a very well built frame with proper front and rear ends can be literally ruined if the various chassis control items are not up to par. We're speaking directly about the shock absorbers, springs, wheels and brakes. To have a first class car, no matter what category it might fall into, these four items must be good. Let's take a close look at these appointments and their application to good cars.



A fine example of a rod incorporating many new ideas in special car suspension. Coil springs fit just ahead of tube shocks, axle is held in proper place by spring leaf radius bars. Building a system like this is often easier than making older types perform satisfactorily.

SHOCK ABSORBERS

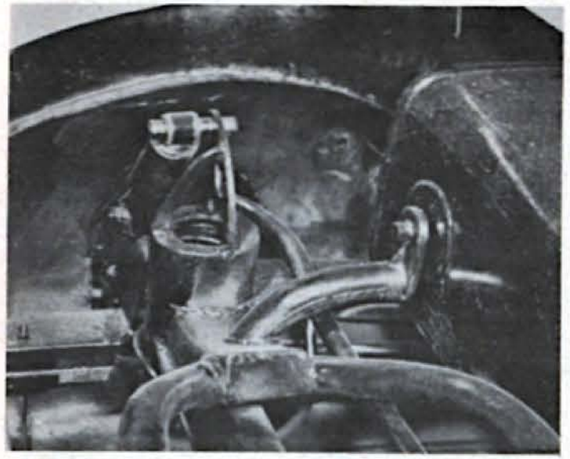
Good shocks are absolutely essential on a rod if acceptable riding qualities and handling characteristics are to be realized. Not only must the shocks be good, they must also be the right type. Shocks which dampen the spring action too much can cause the car to ride hard. If they do not dampen the spring action enough, the car will bounce excessively and the ride and handling can be miserable. For these reasons shock tension must be just right for the car.

Shocks which don't control spring action during both compression and rebound permit the frame to drop abruptly on quick turns, making the car hard to control. Shocks of this type also permit inertia forces to lift wheels off the road surface after they pass over a bump, affecting passenger comfort. For these reasons shocks should be double acting.

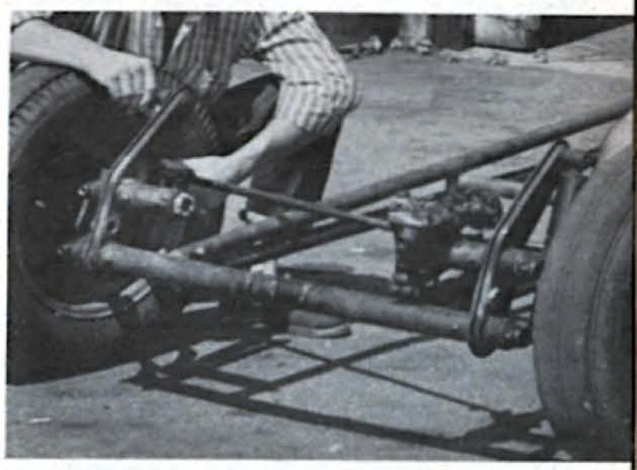
The term "shock absorber" isn't entirely accurate since it is the duty of the chassis springs to absorb shocks due to wheel or frame movement. Springs serve two purposes: (1) to hold the frame and body in their correct vertical position over the axles and (2) to permit necessary movement of the axles as the wheels pass over uneven surfaces. An ideal suspension system would be one which would hold the frame of the car in its correct relative position to the road while at the same time permitting the wheels to maintain constant contact with the road under all conditions. This is seldom the case, but shocks help the cause since they dampen and control the spring movement.

We have all seen and possibly driven cars with worn out shocks. Each bump or dip in the road causes the chassis to bounce up and down several times in an unrestrained manner until the energy imparted to the chassis by the bump is finally dispelled. An equally irksome, but more dangerous, effect of worn out shocks is the bouncing of a car's wheels when the brakes are applied on a rough street. This condition is only for the driver having a king sized hero badge.

Incidentally, it seems to become widespread fashion to run a car on the

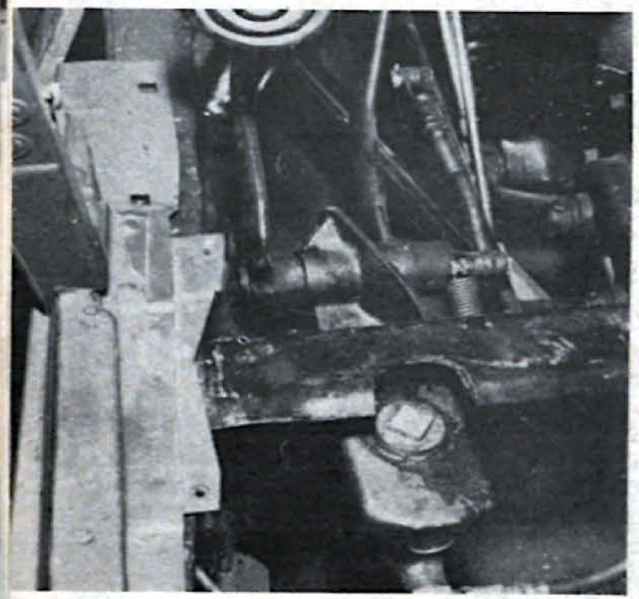


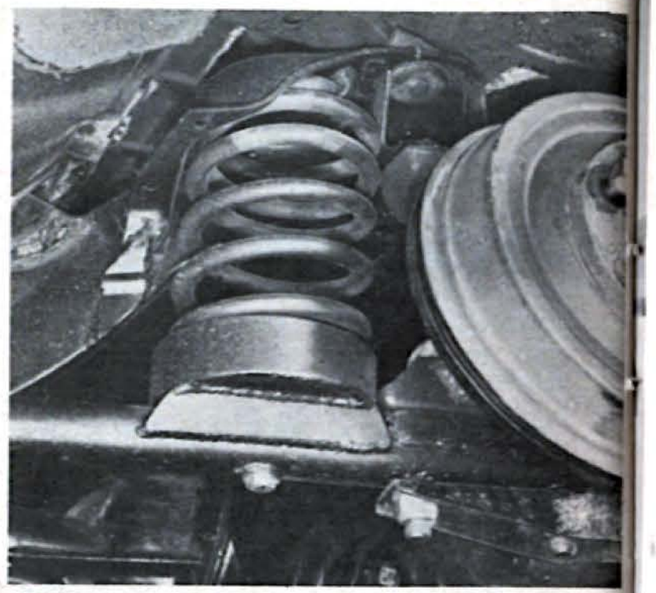
Model A rear crossmember has been cut and fitted with spread-tube center, special towers built to hold coil springs.



A Volkswagen front end adapted to a dragster frame needs only one torsion bar; upper bar has been totally removed.

Coil springs and positioning pads may be located on strong radius rods rather than directly on rear end if installation requires such.





A '32 Ford center crossmember may be modified to take the hydraulic brake mechanism from a '39 through '48 Ford.

To raise and lower rear end of car having semi-elliptic springs, use shackles with several equally spaced holes. The same idea will work well on a Ford rear end.

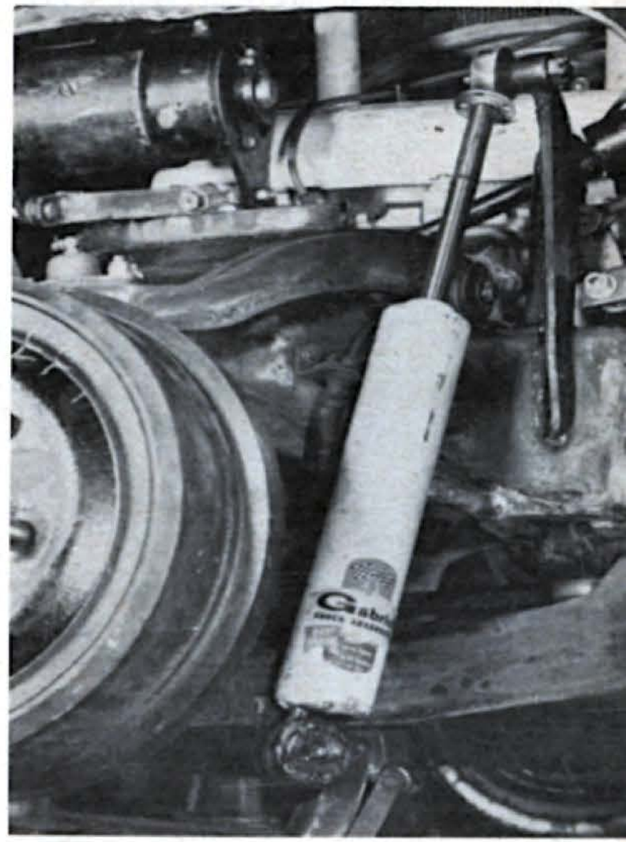
street as it would run on the strip, i.e., no hubcaps, scavenger pipes, etc. The first yo-yo who pulls into your local drive-in with the front of the car waving in the breeze and claiming he is a hot drag strip boy, ignore him. If he had any sense and knowledge about cars he would have long since put good shocks on the car. Worn shocks are used at the front by sharp stock boys running at the drags for extra weight transfer, but they change at the strip, using good shocks for normal driving.

Shocks have been made in a variety of types. One of the most popular in its day was the "Hartford," a friction type employing two steel arms and friction discs. An end of one arm was pivotally mounted on the frame and an end of the other arm was similarly mounted on the axle. The free ends of the arms, with the friction discs between, were clamped together with a single bolt through the center of the discs. Tightening the nut on the clamping bolt exerted tension on the arms through a convex spider-type spring. Friction between the arms and discs resisted movement of the arms and controlled the spring and/or frame movement. The amount of friction and consequent dampening control could be increased or decreased by tightening or loosening the clamping bolt nut.

This "Hartford" principal has been in rather widespread use of recent date on drag cars. Because of such popularity and the light weight, this type of shock is even now being produced commercially by several speed manufacturers. The new type shocks are normally a single arm similar to the standard "Houdaille" type control lever. At the big end the arm connects via a large center bolt to a chassis mounted plate or disc. Between these two surfaces there is some kind of material, such as leather. The two surfaces are squeezed by a spring (coil or spider-type) between the control arm big end and the head of the center bolt. They seem to work very well on competition cars, but just aren't suited for constant use on a street vehicle.

A step forward was taken in the shock field when the non-compressibility and flow characteristics of a liquid were used. Such "hydraulic" shocks are normally of the single or double acting variety. That is, they work both up and down, or one way only. Single acting shocks were built on the theory that resistance is not needed during spring compression, therefore they retard movement only during the rebound period. Double acting shocks retard movement in both directions.

The first hydraulic shocks were of the indirect acting type and are commonly called lever or arm shocks be-



Heavy late-model stock cars used for track racing must have extra shocks such as the Gabriel unit. On all installations, the shocks and brackets must be strong.

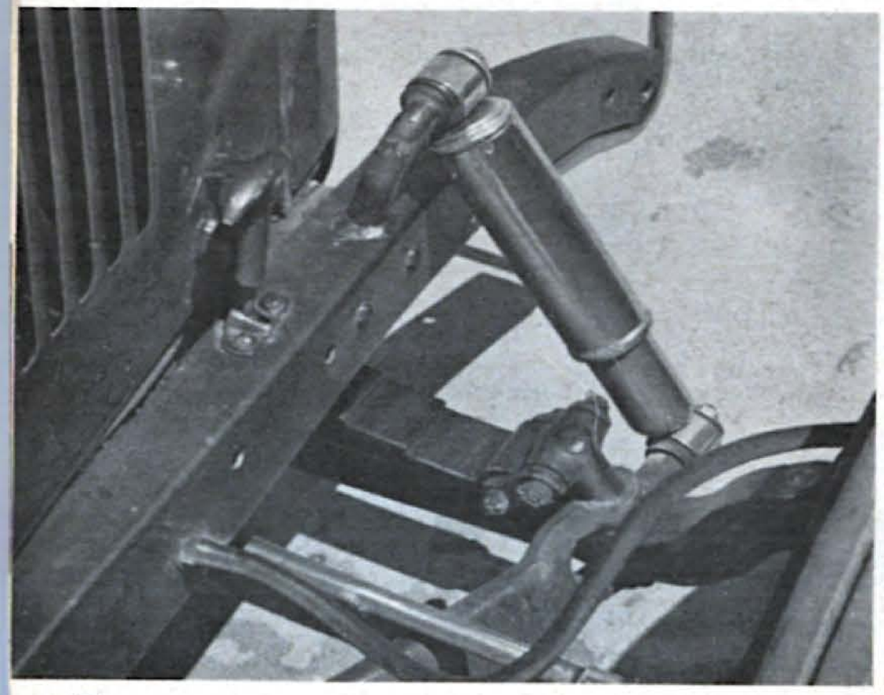
cause of the operating arm they encompass. Lever shocks are made in two common types: piston and rotary vane. Both types create resistance by forcing a light-bodied oil through metering orifices. Piston type shocks use one or more pistons, linked to the lever arm and operating in cylinders. The rotary vane type uses moveable partitions which move with the shock lever to force the liquid in and out of stationary compartments. Houdaille (pronounced Hoo-dye) lever type shocks for early Fords are of the rotary vane type. Some lever shocks have an adjustment by which their resistance characteristics can be changed. You won't find this feature on the older stock Ford shocks, but you can buy stock type shocks from a parts house that have been modified to give 50-50 action.

These shocks give equal resistance to movement in both directions and are easily adjusted from free action to practically immovable. They are very popular with competition car builders.

Although 50-50 shocks are ideal for rods, the trend in recent years has been to airplane or tube shocks. They look "racy" but do require some installation problems. This type of shock utilizes a piston and cylinder. During spring compression and rebound the piston moves in and out of the cylinder, creating resistance in a manner similar to lever type piston shocks. Some new direct acting airplane type shocks may be adjusted for the type of control desired.

Just remember when you're going to install a set of direct acting tube shocks that they have been designed for some specific weight of car. Don't go putting a set of shocks off a 4000 pound car on a 2000 pound rod. Efficient shock operation demands positive connections between the shock arms and the units they should be helping. Any sloppiness in the connections permits uncontrolled movement and a resulting loss of handling and riding quality.

We have known many special car builders who have built their cars with very "soft" springs, then using firm shocks to control the handling of the car. Actually, this is an almost universal procedure among builders of any kind of car that has to handle, be it Bonneville, road races, or Indy.



Typical tube shock installation on early lakes roadster. Shock mounts were butt welded to frame and front side of dropped axle. On using tube shocks, make sure they were designed for car with weight near that of the rod.

SPRINGS

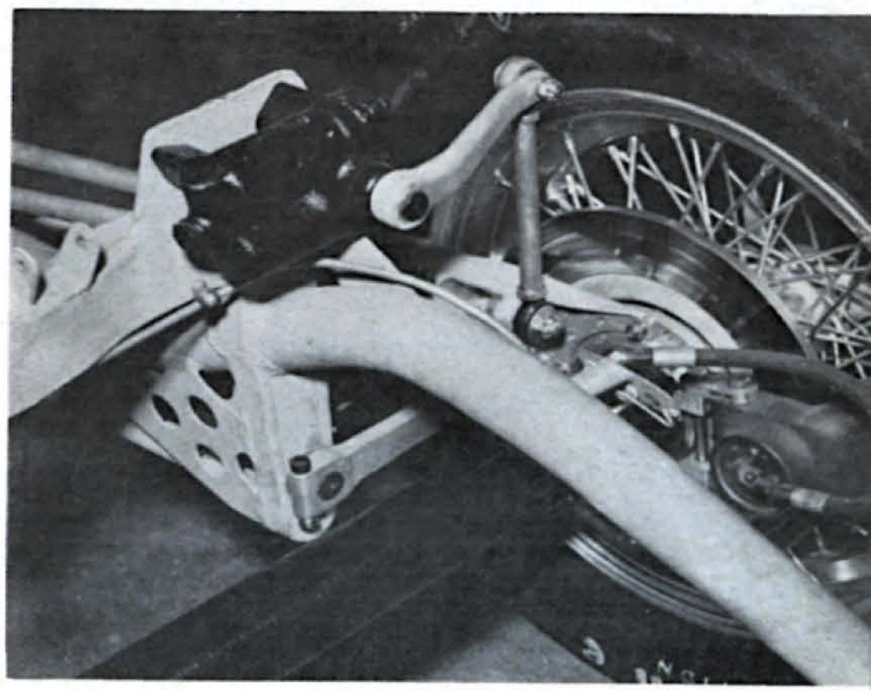
If you've ever ridden far in a car having faulty or no shock absorbers, you are very familiar with springs. It is amazing how high a car will bounce when the actions of the springs are not controlled. For our purposes, we may lump springs into three types: leaf, coil, and torsion. To consider the torsion bar a spring might be stretching things a bit, but we do it anyway. First there is the case of the leaf spring.

LEAF SPRINGS

In rodding we are interested in only two types of leaf springs. They are the semi-elliptic and the transverse. Sure, there are countless methods of mounting numerous leaf spring designs. But we are concerned with just these two, since they appear 99 and 99/100 per cent of the time. Pre-1949 Fords used transverse leaf springs. That is, only one spring was used at the front and one at the rear. These springs were mounted crosswise. Other cars, such as Chevy, Dodge, etc., used semi-elliptic-type springs. That is to say that two springs were used on each end and they were mounted parallel with the side frame rails. On the transverse mounting, the center of the spring mounts solidly to the frame while the ends connect through shackles to the ends of the axle. To all intents, spring action on this type of frame is kept to one end or the other.

Semi-elliptic-type springs have the ends mounted through shackles (more properly, one end is usually shackled, the other mounted direct) to the frame. The center of the spring mounts to a perch on the outboard end of the rear end. Thus the entire spring is caused to act or deflect in this case.

As far as one type being better for our purposes than the other, well, it's just a toss-up. The transverse type has been a rod tradition for years. This can certainly be attributed to the high popularity of Ford cars. And if you happen to be building a little car, the

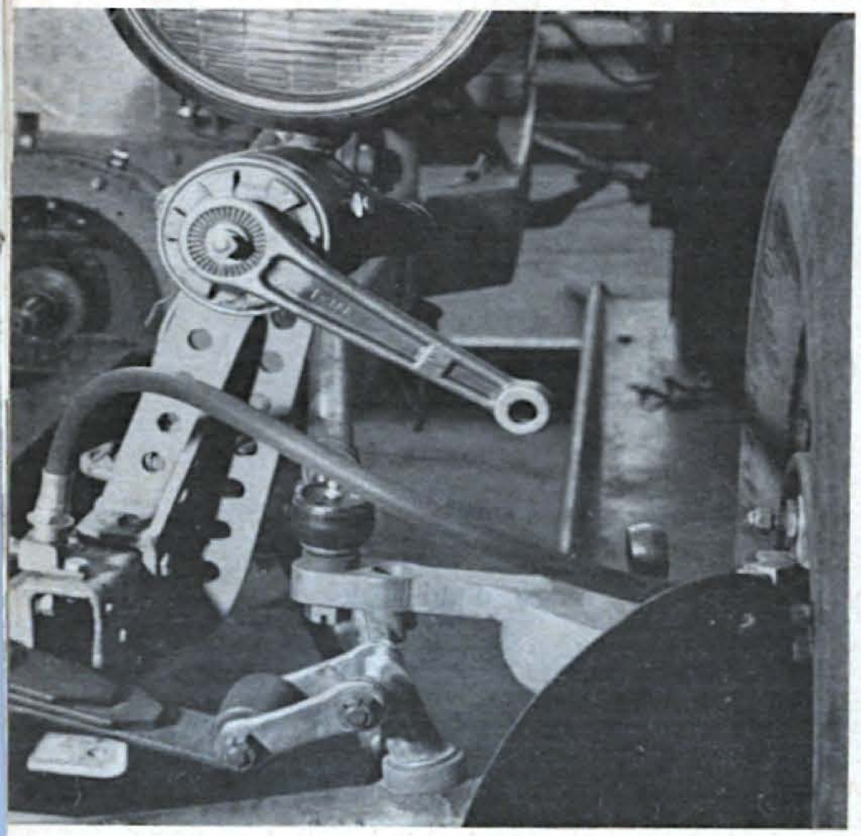


Contrary to popular rodding practice and belief, lever arm shocks are not obsolete or old fashioned. They work extremely well and are often much better to use than tube counterparts. Arm below shock and ahead of plastic taped axle is for torsion bar.

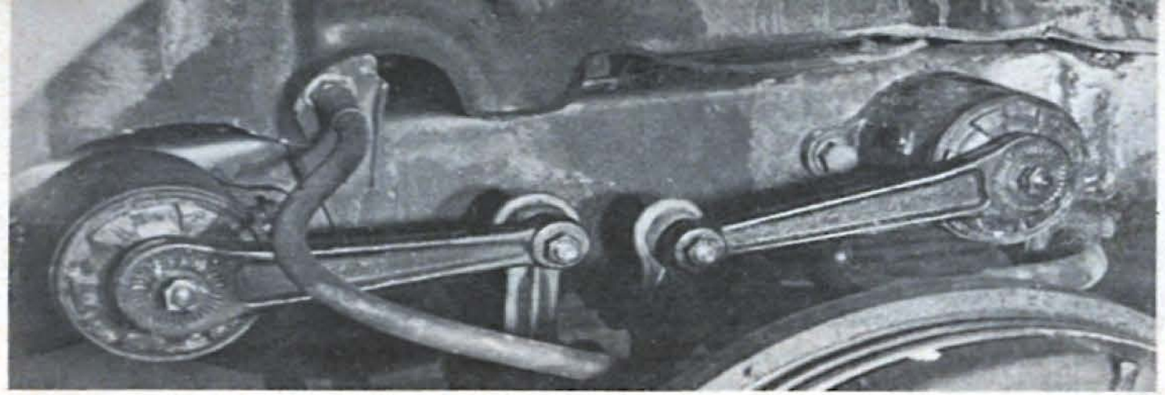
transverse spring does away with long spring mounting frame horns front and rear. This type of spring gives reasonably good immediate handling characteristics too, mainly because it is stiff acting. On the other hand, the top sports racing cars have been equipped with semi-elliptic-type springs on the rear for years. Actually, it boils down to which type is easier to install, and what is on the car now. Unless you're going to build some way-out piece of iron, you can take maximum advantage of whatever you already have. Our own personal experience has been that the transverse spring is an easy way to get reasonable road handling, while the elliptics give best ride. So—let's assume that you're going to use whatever type of spring you already have. Then what you want to do is get good service from them.

Many leaf springs are fitted at the factory with dust covers. Don't underestimate the value of these often ungainly looking items. On any movement of a leaf spring, the leaves rub back and forth on each other, especially toward the ends of each leaf. With some type of dust covering, the spring is protected and may even be lubricated. But suppose the springs are open and the desire is to make them nice in appearance and at the same time make them trouble and squeak free.

First, disassemble the spring. Best method is to secure the center part of the spring in a compressed fashion in a vise or healthy C clamp. Loosen the centerbolt holding the springs leaves together and at the same time loosen the vise or clamp. Clean and inspect each individual leaf, paying very close attention to the main leaf (the one with the mounting circles at each end). Replace any leaves showing the slightest



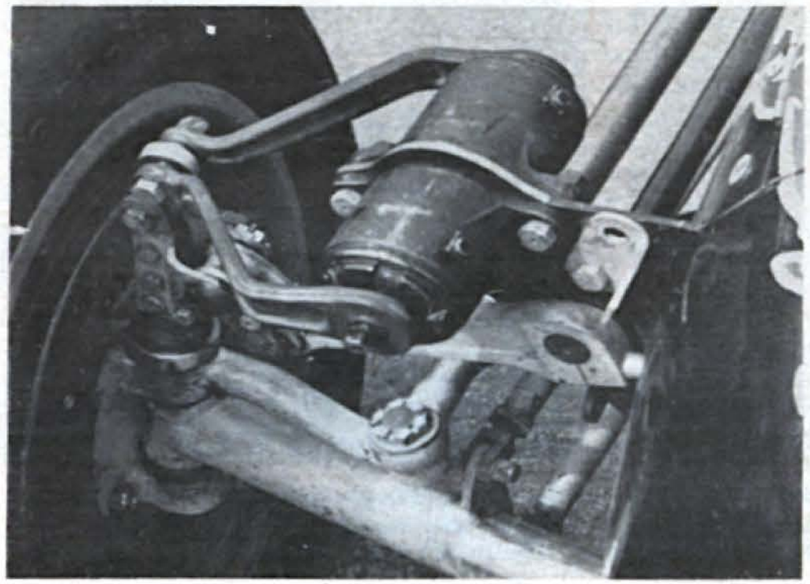
Competition car has boxed frame, reversed spring main leaf, extra-sturdy steering arm, high shock mount, Houdaille 50-50 type shocks.



For special purposes, the addition of an extra shock might mean all the difference in the way a car handles. Keep close check on all linkage to cut sloppiness.

sign of cracks or undue wear. A good buffing with a wire brush will make doubly sure the leaves are clean. Now use a top quality grease or suitable compound and coat the rubbing surfaces of each leaf. If you really want to do an outstanding job, cut strips of copper screen wire to fit between each leaf. This will tend to hold the grease in after the spring is reassembled under compression. Assemble the spring and wipe all surfaces free of grease. Use a really good quality electricians plastic tape and tightly wrap the spring from one end to the other. (This will give a professional look to the spring too. It is a method of sprucing up the springs that many top show car builders use. Spring and torsion bar wrapping is also used on circular track cars.) This wrapping isn't entirely necessary, but it does help to keep the spring free from dirt and grit and keeps the grease in. If you have a chromed spring you'll have to be content to either let it be or keep it wiped dry. One thing is certain, you'll be absolutely amazed at the new life the spring seems to have. And boy, does it help those old transverse spring Fords.

Whether the springs to be used are transverse or elliptic type, the need



An Indy car with home-made tube axle, torsion bar suspension, right hand steering connection, double Houdaille shock absorbers.

When dismantling and assembling a spring, always use a good C-clamp or vise. Clips at ends of the springs keep leaves in proper alignment. Replace broken leaves.

might arise for modifying them to some extent. This is usually done to lower the car. Right here and now may we state that although longer spring shackles might lower the car, spring re-working is the best of the two ways. Secondly, heating the tips of the springs so they will bend and drop the car isn't the answer either. This just puts a bind on the spring leaves that can't be relieved. So, that leaves de-arching and reversing of the main leaf eyes. We don't recommend reversing the main leaf eyes since this is usually a heating process. We've had several such jobs break right at the ends, causing slight embarrassment.

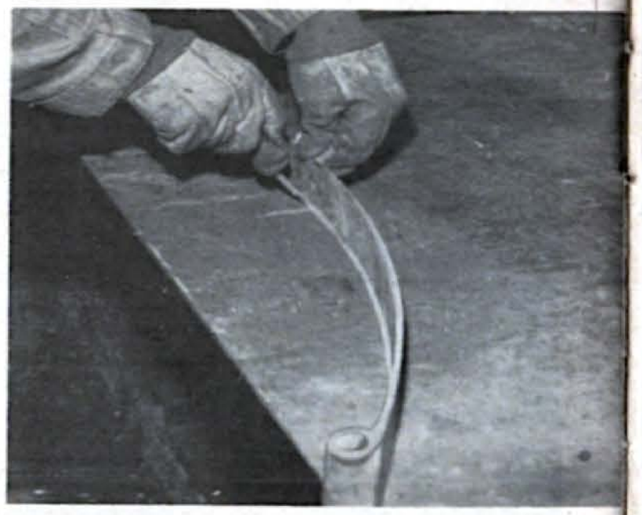
SPRING DE-ARCHING

Many special car builders feel that heating a spring, such as might be done when reversing the eyes, can draw temper which can never be replaced in the same degree. So that leaves de-arching by one of two methods, cold-rolling or hammering. If you live in a big town where a shop has a heavy bench mill, the springs can be flattened or reverse rolled. If not, a large size hammer will do the job.

The spring is laid out on a flat surface. The tips of the eyes are placed at the base of the working surface and a chalk line is made along the contour of the leaf. This serves as a pattern for the re-arching in later stages.

The leaf can then be placed on a block and pounded flat with an iron hammer and lots of muscle. When the leaf is flat, it is reversed on the block and hammered into a reverse arch. When the leaf looks as if it is shaped right, it is checked against the chalk line. The main leaf is usually done first. Each subsequent leaf must be checked with the main leaf for proper arch and spacing. The second leaf should have ¾-inch of space between the peak of its arch and that of the main leaf. The third leaf should have ½-inch space, while the fourth leaf should have ¼-inch space. Each space gets smaller as the leaves pile up, which goes for any spring, re-arched or not.

The assembled spring, treated thus, has the same action as it had originally, except that the total effect is a lowering of the car by the amount of the diameter of the spring eye. If desired, a further bit of lowering may be achieved in the re-arching process simply by putting a little less arch in the spring than it normally had.



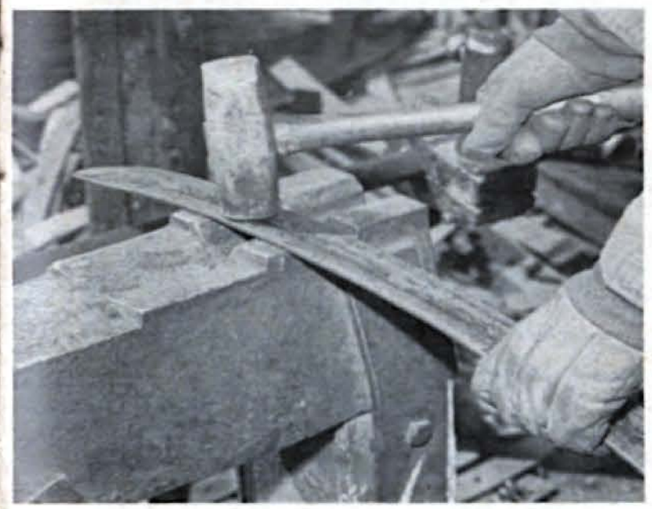
In de-arching, first mark contour of main leaf on fixed surface before starting to do any reshaping of the leaf.

COIL SPRINGS

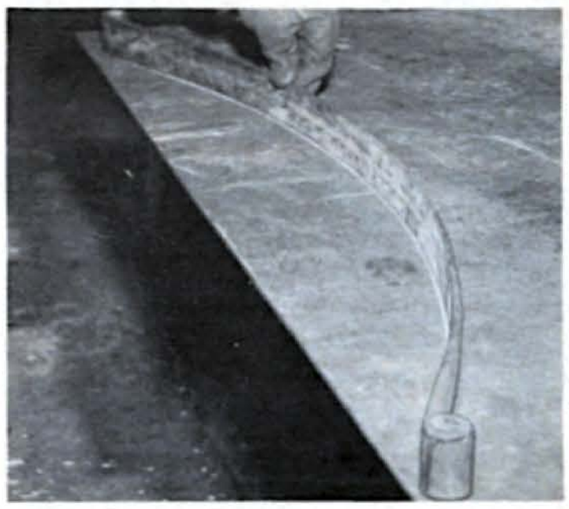
If the springs in question are coils, then the car is probably a newer model or possibly a pre-war Buick. Most of the problems with coils arise with modifications of some sort. Usually the desire is to lower the car, or in some cars to change the spring rate. Let's take the spring rate first. Two quick and dirty ways to do this is to either look around for a good swap or use rubber air bags. Suppose a stiffer spring is wanted for the front to hold up a heavier engine. Use the coils from a heavier car having a big heavy engine; use station wagon coils the same make as your car (they are often heavier); or try and get the optional items some manufacturers list for their cars. These last coils are usually listed as taxi or police options. Same thing goes for the rear of the car. If you don't want to change springs, then look for a good set of air bags. These bags fit inside the springs (not if a shock is in there) and may be inflated varying degrees.

To lower the car by modifying the springs goes something like this. Remove the coils and chop them the desired amount and re-install. Don't cut too much or the front end can't be aligned. Best bet is to buy a lowering kit from your nearest speed shop, but even then it isn't the greatest. We like the use of specially built spindles best.

You may have a rod and desire to use coil springs. This is usually done to the rear only, so we'll tell about that. Some rear ends use coils, whether of an older or newer model car. If such a rear end is to be used under your rod, the installation should be as simple as possible. For this reason, it is best to pirate as much of the original rear end installation pieces as possible. For instance, a frame incorporating coils at the rear usually has some type of pad that becomes the upper spring perch and locater. In this case, just take this pad and weld or bolt it directly to the rod frame. But wait! The rear end of the



Pound main leaf with heavy hammer to flatten and curve the opposite direction. Go slowly, do not heat any spring leaf.



After the main leaf has been hammered to a reverse curve, check the new contour with the original, stop when they match.

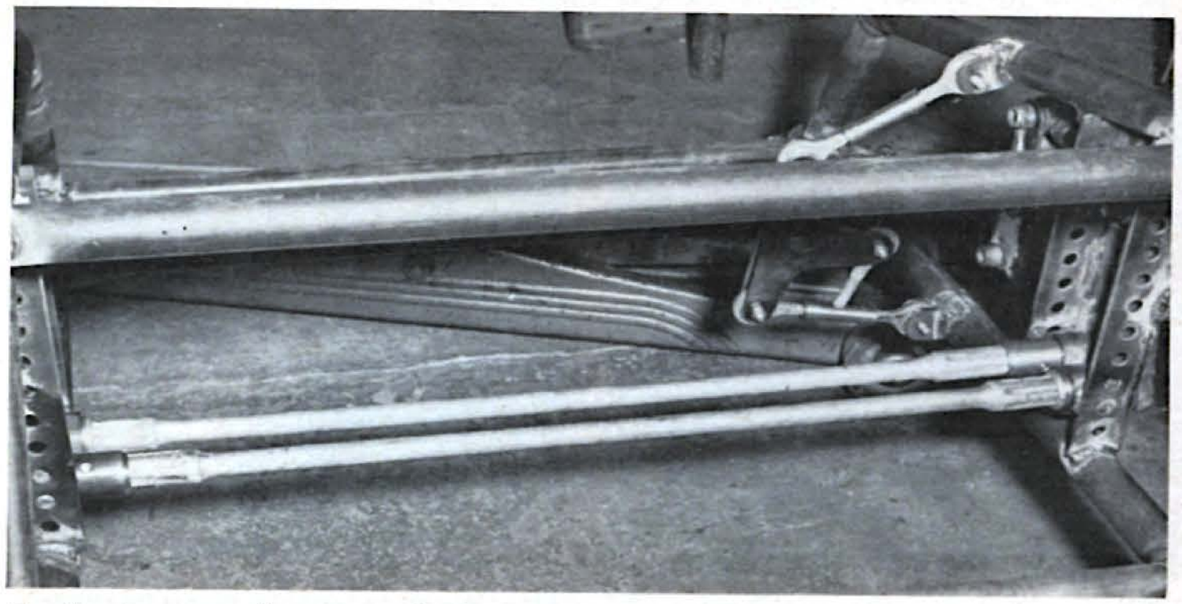
rod now sits a mile high, or so it seems. The weight of the car originally using the coil spring rear end was probably close to twice that of the rod, so it is necessary to shorten the coils for the new car. This will, in effect, make the ride stiffer. If the coils aren't to be shortened, then the upper spring pads must be relocated higher on the frame. Not a really quick chore. Either way, use of existing coils is relatively easy, and does away with the long elliptic or transverse type springs.

Assuming that a bit of work may be put into the coil rear spring suspension, then there are basically two modifications to consider. Number 1, putting in some type of coil with a deflection rate compatible with the light weight of the rod, and 2, using an air suspension of sorts.

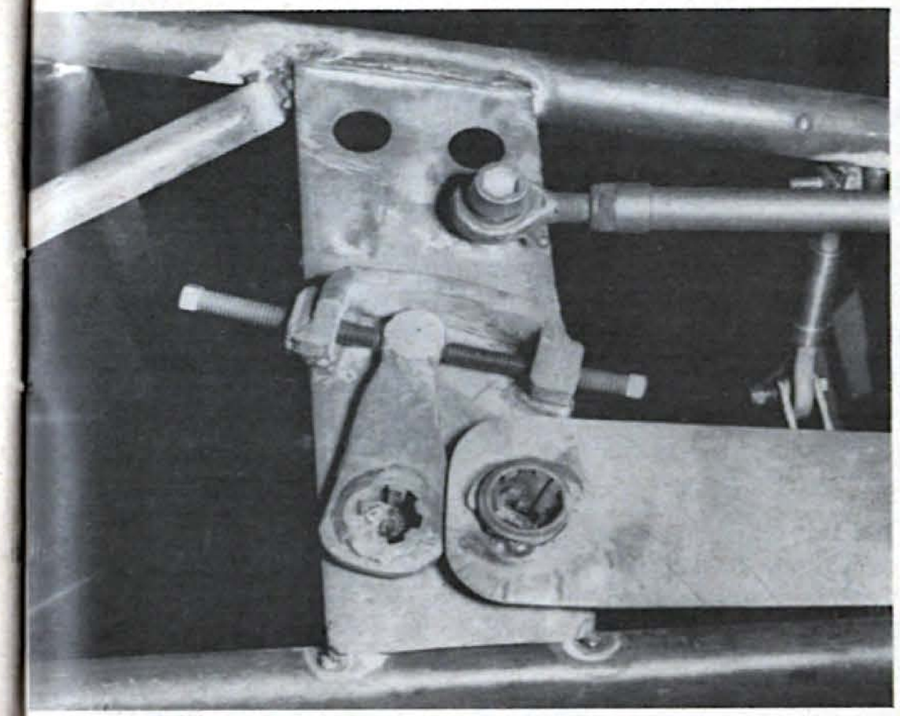
Let's check out the former process first. Space limitations will enter the installation picture quite often. The large diameter coils used on stock cars might be just too bulky. Looking around, it will be noted that some of the small import sports and economy cars have the right size springs, and the weight of the cars is close to the rod. Some trailer accessory coil springs will work, but they are usually quite stiff. When using these types of coils, it is necessary to fabricate new perches for both the rear end housing and the frame. Nothing hard here, just remember to bolt each end of the spring down so it doesn't jump out of the perch on rebound.

While you're looking around at various suspensions, you'll probably note the use of air bags inside coil springs, especially on rear ends. Designed primarily for use as overload devices, these bags work equally well on light rods. Just find some very light coil spring that will fit around the uninflated size of the rubber air bag. Air bag overloads designed for elliptic type springs usually have such a spring. All it does is serve to keep the bag from ballooning. Build perches for the spring, insert the bag, inflate to a good riding and handling pressure, and you're in business.

Just never overlook a couple of mighty important items on this kind of



Torsion bars may be mounted along the frame or across it. In transverse mounting one bar is fixed solid on one side while the other turns in a sleeve on that side.



Bars on opposite page are controlled by these arms, one connects to the axle, the other to set tension on the bar for any pre-determined ride, Note splines.

suspension (coil). Always, but always, have sturdy radius rods of some sort and a sturdy, well mounted locater bar. This latter is a bar running parallel to the rear end that serves to keep it running true. Such bars are common on Buicks and some '47-'48 Fords.

BRAKES AND WHEELS

Here is an area so vast that we just can't possibly delve into it. Suffice it to say that due to the interchangeability of most car parts, especially of same-make cars, getting hydraulic brakes is easy. Making special brakes for a car, such as utilizing the finned Buick drums, is a matter for machine work. Just pick a brake system that will do the job you require, and make sure it is in top working order.

As far as wheels go, you're on your own. If the problem is one of interchangeability, see your junk yard. They should have a book on interchanging parts. On Fords, the problem is usually how to get some specific size wheel, or rim width. For spoke wheels, Ford or Kelsey spokes were made in the 16- and 15-inch sizes. For disc wheels, use any pre-'49 Ford or Merc wheel for 16-inch tires. 15-inch wheels were used on the '48 through '51 Mercury and will bolt to pre-'49 Ford hubs. To go down to the 14-inch size wheel for early Fords, all you need are units from a Chrysler Imperial. 14- and 15-inch spokes are available in Imperial and Cadillac wheels, the Imperials fitting but the Cad items require relocation of the studs in the drums.

For certain you may have considered reversed wheels. They seem to work OK, but don't fail to investigate proper front end geometry and its relationship to wheel centers. Reversed wheels on the rear do not have any noticeable adverse effects.

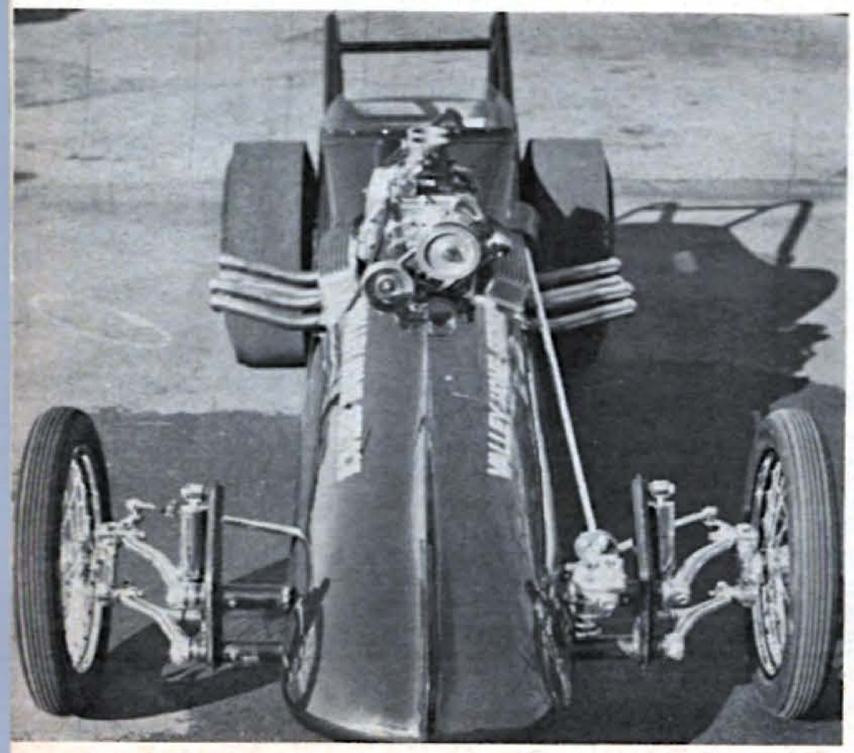
As far as special alloy wheels, if they are to be used on the street, maintain a constant vigilance for nicks or chips. Such things can lead to cracks and ultimate wheel failure. The wheels work fine, they just require some attention to condition. ■

NEW TRENDS in CHASSIS DESIGN

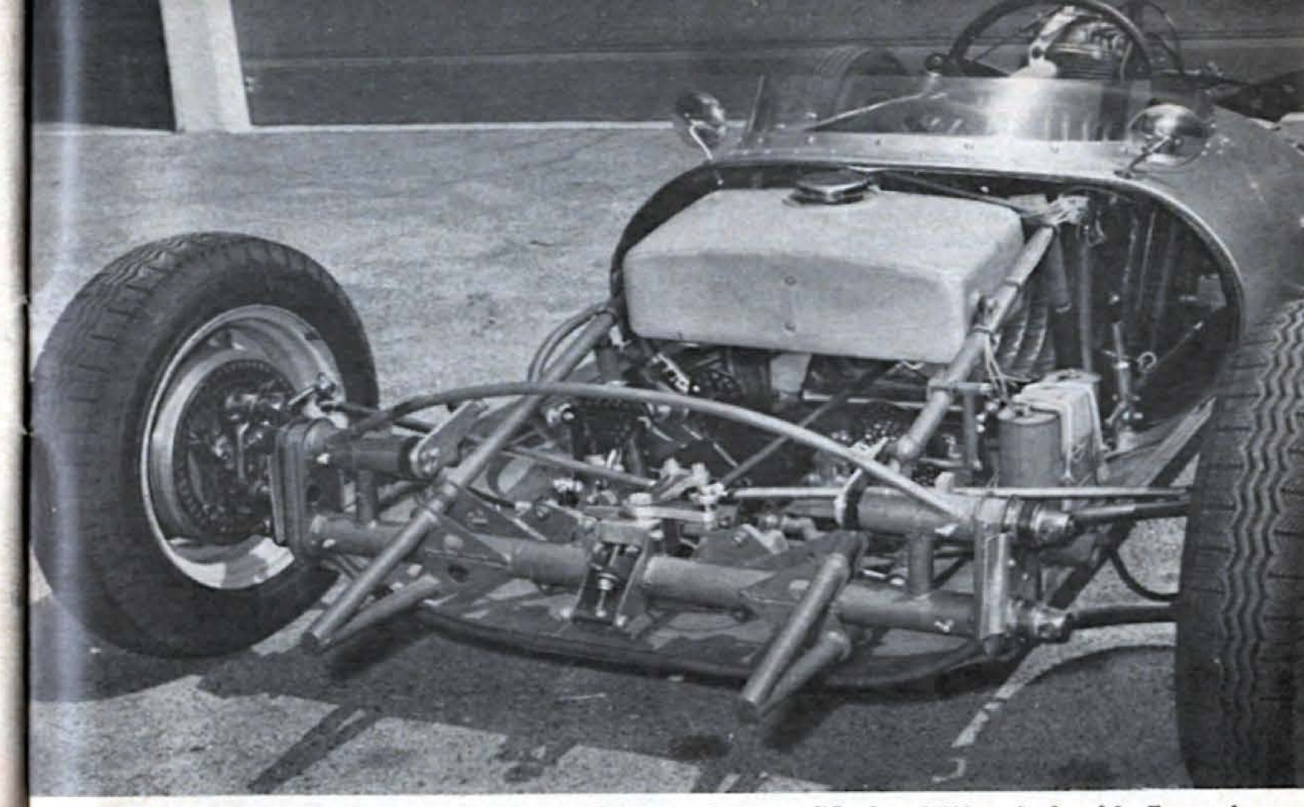
BY ITS very nature, hot rodding is a trial and error game. Having little to base action on, builders of rods have come along fairly sedately until now. Apparently what was needed was a fast paced space age to accelerate thinking, or a vast army of enthusiasts.

Until recently, it has almost been unwritten law that a rod be based on early Ford components or similar items. Deviation was rare and, strangely, seemingly frowned upon. But of late the rodding world is growing at a rate nearly impossible to keep track of. There have been notable increases in performance at Bonneville and the drag strips. This performance was generally attributed mainly to engine power. But just stop a moment and reflect on the small but numerous changes that have taken place in chassis and related components. If all these changes were incorporated into one car, the evolution would be easily apparent.

Torsion bars are an example. Because of the widespread acceptance of this principle of springing (due to sports cars and Chrysler products) many rods are being built using same. How? Simple, just pirate the necessary locat-



The use of Volkswagen front ends is becoming widespread, especially on lightweight competition machinery. Easy to modify and install, such items are relatively inexpensive, present a little challenge to a serious rod builder.



Chuck Nerpel, editor of Motor Trend Magazine modified a VW unit for his Formula Jr. racer. Note the simple drag link to center cross steering arrangement used.

ers, links, etc., off a car having them and put them on the rod. Usually a builder doing this will make smaller locaters for appearance sake, but the application is easy. Wrap the bars with plastic tape if they are very small or might be subjected to getting rock nicks like a track racer. Torsion bars may be mounted parallel to the rails or across them, at the front or at the rear. Torsion rate is related to size and length of the bar.

In event that you have a light rod, you might consider the use of an entire Volkswagen or Porsche front end.

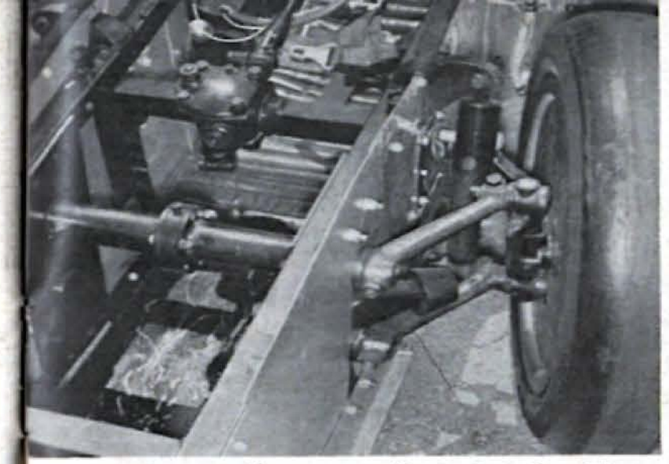
The Volkswagen front end assembly is ideally suited to be used on any type of hot rod, be it dragster or street roadster. This suspension is of the trailing parallel link type. The entire unit is self-contained even down to the steering gearbox and merely bolts to the Volks frame. Two hefty horizontal tubes mount one above the other and perform the double duty of a front crossmember and a housing for the two torsion bars. The upper and lower trailing arms on each side are secured to the square laminated torsion bars by Allen head set screws. Machined tubular surfaces on the trailing arms are positioned within the torsion tubes by long life bearings of phenolic material. A single set screw in the center front of each cross torsion tube locates the torsion bars. Late model Volkswagens feature 8½-inch brakes, quite sufficient if you're building a very light rod. Otherwise, you'll have to fit new hubs, drums and backing plates which isn't

overly difficult (Porsche units bolt right on). These front ends are built for long life under extreme conditions and incorporate several features for normal adjustment. The top and bottom ends of the spindle support are held to the trailing arms by studs similar to small king pins. These studs are located by a slotted groove and a cinch bolt. Normal wear at these points may be taken up by loosening the cinch bolt, rotating the studs the required amount, and tightening the bolts. Incidentally, it is at the studs that camber is set. Each stud has ten shims on it, with the camber being determined by the number of shims between the spindle support and trailing arm. The remainder of the ten shims are placed elsewhere on the stud, usually between the stud head and the support. This is merely to keep the stud length proper for tightening.

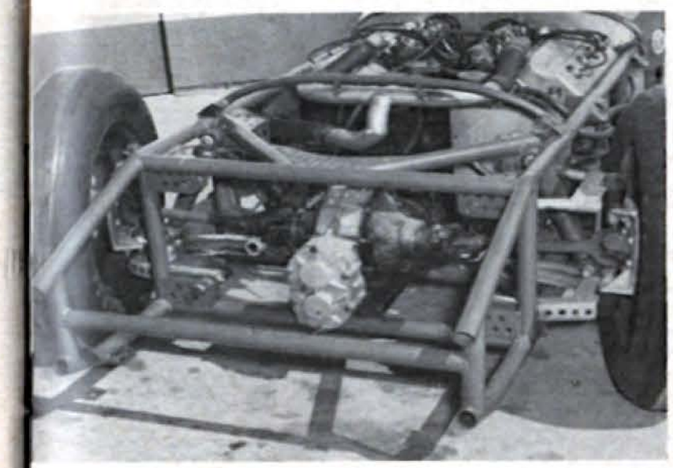
Shock action is handled by tube shocks mounted to towers on the cross housings and the lower trailing arms. On dragsters this shock arrangement is normally retained, but on street rods modifications are often necessary for appearances sake. This problem is usually handled by cutting the shock mounting towers off near the upper cross tube and substituting upper shock mounts on the frame in the normal manner. A small bracket is then built to connect shock and lower trailing arm. If you're contemplating Houdaille or friction type shocks the connection is much easier.

Mounting the front end to the frame is as easy or difficult as you care to make it. If you're building a tube chassis then you'll probably construct the individual tubes to intersect the cross housings. If you're using a channel type frame such as a Model A or '32 Ford, then you'll have to do a bit of cutting and welding. The normal procedure is to position the frame between the cross tubes and add the necessary sheet steel gussets. It must be pointed out here that the Volkswagen front end assembly is bolted to the car with a 2½ degree inclination to the rear of the top cross tube. This is a good measurement to begin with, but in the case where extreme king pin inclination (caster) might be desired (as on a dragster) the center torsion bar set screws and blocks must be repositioned in the cross tubes, or the cross tubes mounted with much inclination.

Up to now we've been primarily concerned with the stock or near stock front end. Suppose, however, that the front end needs some extensive modification for special application. This is quite easy and most all the work may be done in a home workshop. One common modification of the VW front end is narrowing. This is a rather simple procedure and necessitates merely cutting the cross tubes to the correct length and cutting the ends of the torsion bars accordingly. Remember that the torsional action of the bars is directly related to their length. Another rather common modification is the removal of one or the other torsion bars, usually the top, and inclusion of shock links to the applicable trailing arms. Most often this last procedure consists of cutting the center two-thirds of the upper cross tube away. The torsion bar is removed and two short shafts are substituted, one end bolting to the trailing arm in the normal manner, the inner end being secured to some type of shock link. This modification is most common on very light cars where the extra torsion bar isn't necessary. Needless to say some type of bracing for the cut upper cross tube must be provided.



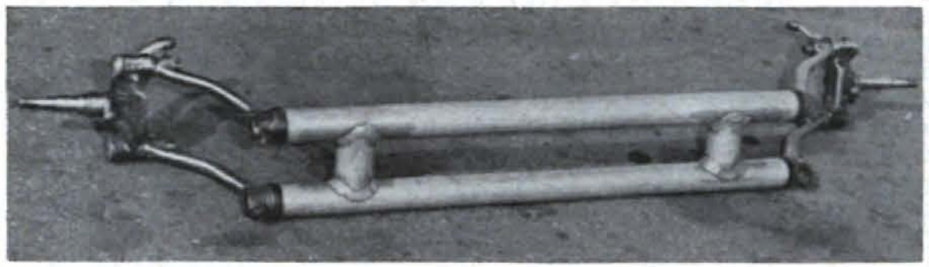
A Bonneville streamliner fitted with a narrowed VW front suspension that has had the lower cross tube and torsion bar removed. System is really simple.



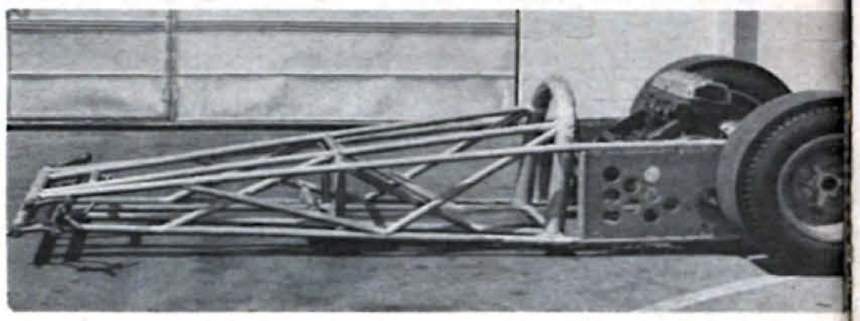
Front wheel drive has invaded high speed Bonneville cars, builders say they handle much better.

STEERING

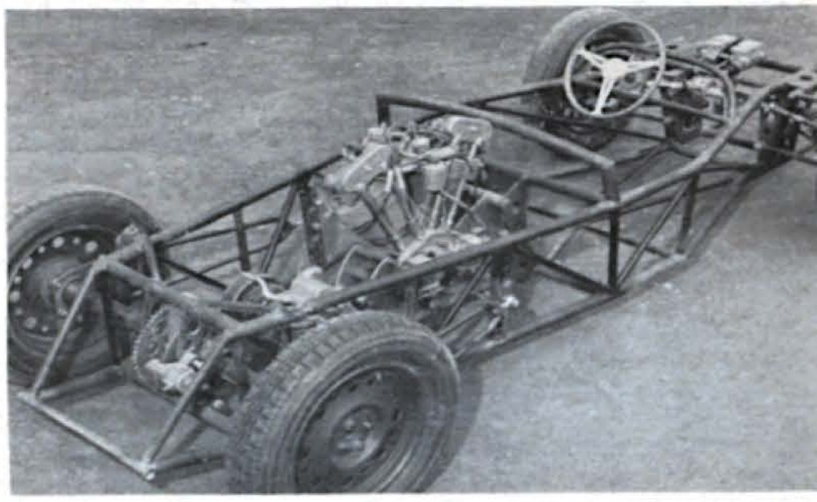
To up-date the steering, one has only to study the various methods of steer-



Chuck Jones chose modified cross tubes, VW components for front suspension on Sidewinder mag chassis.



Jones' rail is an excellent example of modern trends in chassis development, use of easily available appointments.



As simple and flimsy as this chassis looks, the motorcycle engine was discarded in favor of a big Chevy V8. Car is good road racer.

ing used on racing cars. All kinds will be seen. The rack and pinion unit, such as used on Morris Minor, is a small, neat package easily adapted. But watch out, it's fast and sometimes tricky. For light weight, many imports have gear boxes made of alloy, so check them out. No matter what kind of steering is used, one thing remains constant: you must check the completed unit in use before accepting or rejecting it. Most often the installation will require minor adjustment or re-work to make it jell.

Rear ends are also being reviewed, especially now that the trans-axle and swing axle are becoming American bywords. The use of a Pontiac Tempest rear end in a roadster or other light rod would help space problems immensely. Properly installed, it would help the final ride too. Swing axles are available on many imported cars and are easily adapted to a rod. Only big factor here is cost, but shopping around should cure this problem.

Of course, there are ways of building de-Dion rear ends and swing axles from old American standard rear end parts, but let's face it. This is the hard way over the mountain.

One of the most staid of the rod traditions is the channel frame. The tube frame superseded the older fellow's popularity, but it served more to usher in really engineered frames than replace the traditional item. We might attribute the growing use of such things as space, truss, double truss frames, etc., to the ever-increasing awareness by rodders of the road racing game, and vice versa. Putting all those ponies to work has become a problem applicable to everyone. Dragsters have been using modern frame approaches and will certainly continue in this direction. Street machines have only begun to explore the possibilities of better road handling, controllability, etc. Within the next ten years a complete and pleasing change will have transformed the hot rod of yesterday into the dream vehicle of today. Perhaps this book will have helped. ■

Here's that W link again. Unit allows axle to travel up or down without side sway. Simple to construct.

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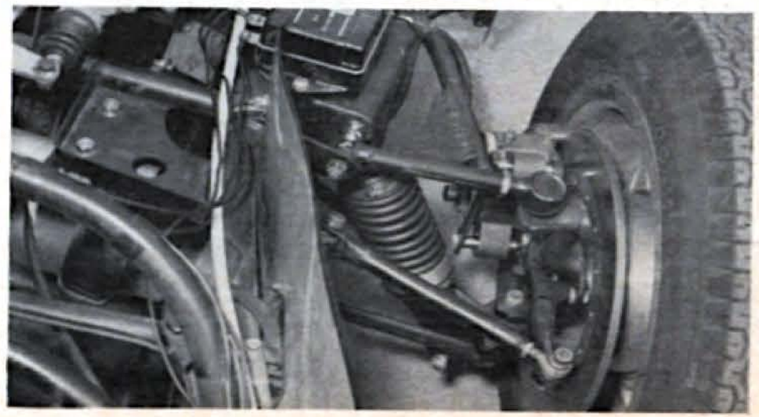
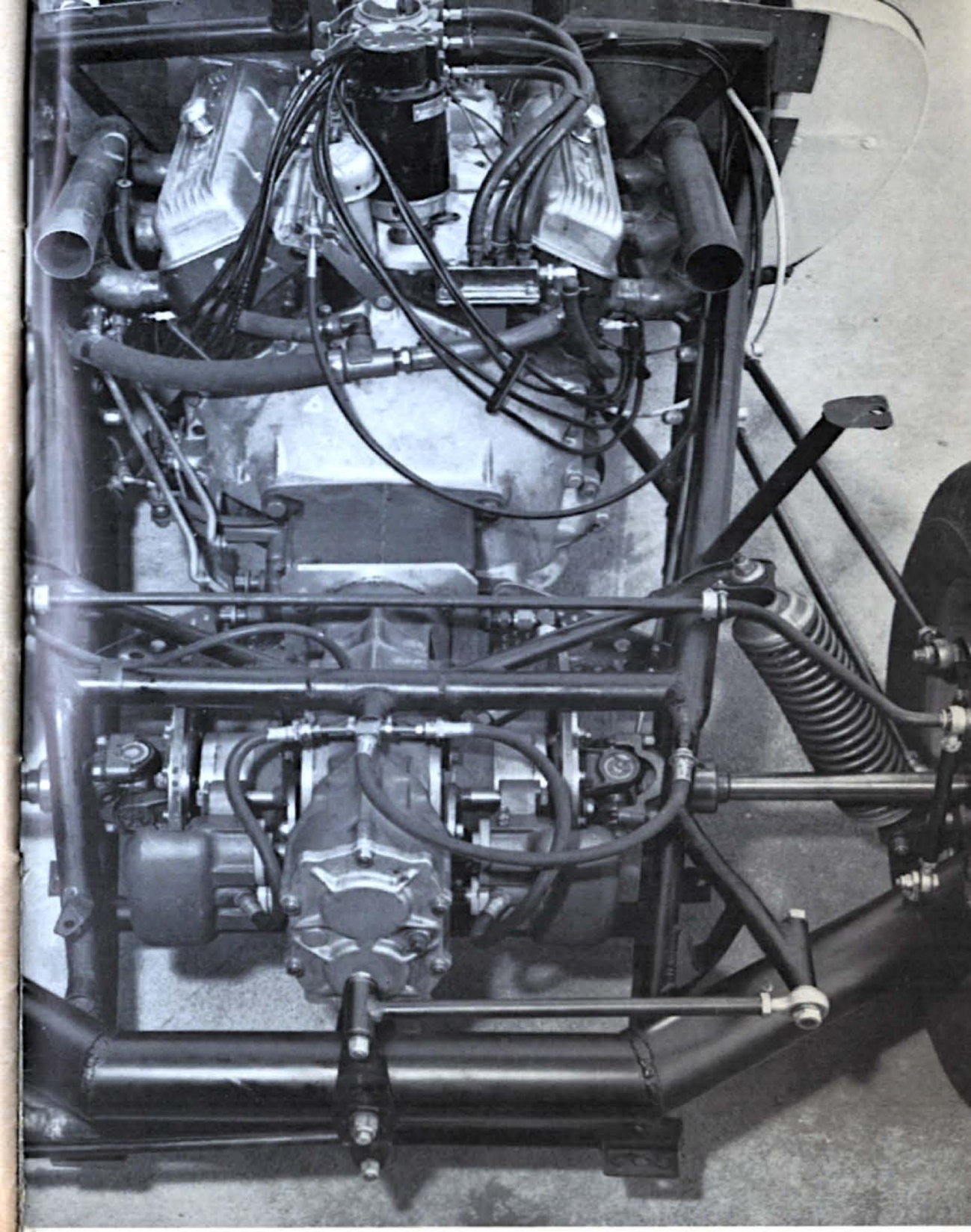
That spindly chassis on page 47 shown here with the Chevy. Swing axle has quick-change, brakes mounted inboard. Note DeDion.



Even A-frames are easy to make using Ford of Chevy ball joint front spindles. All welds must be good.



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