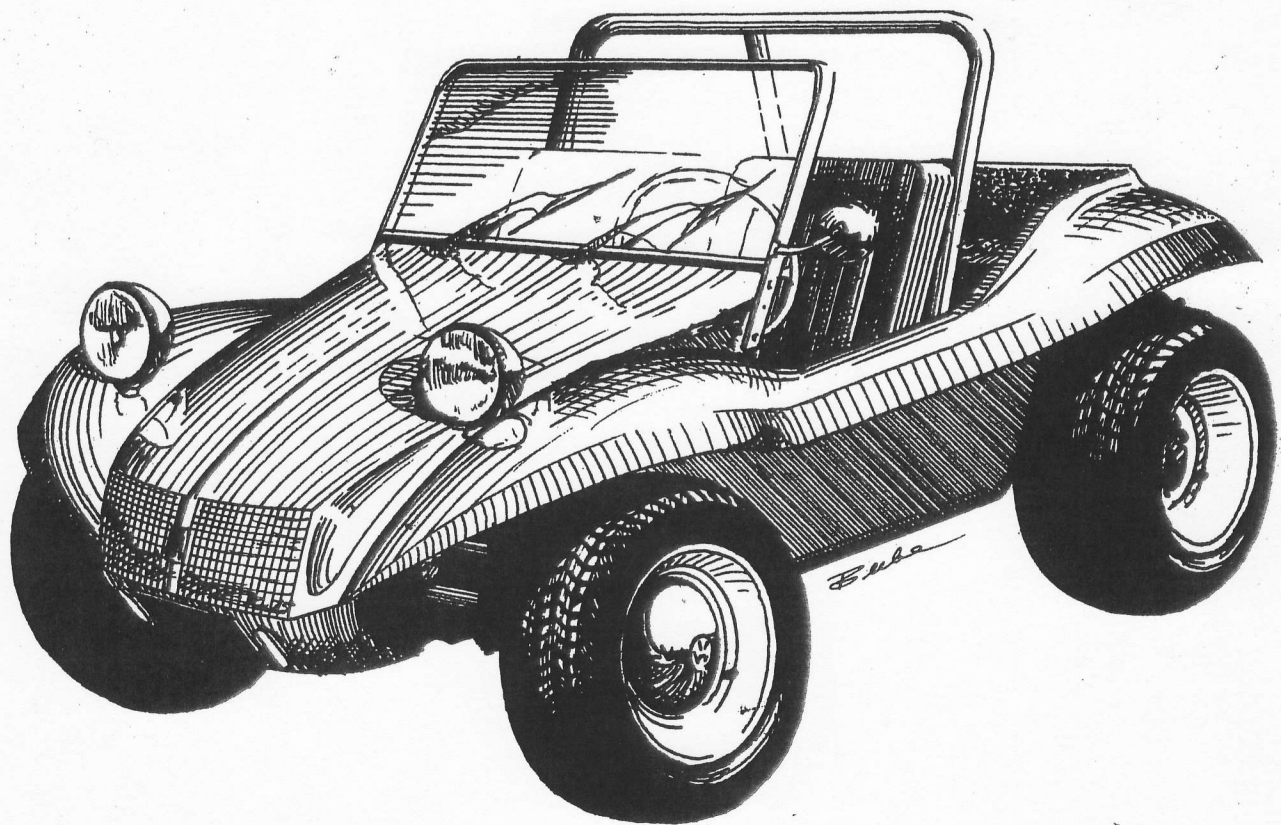


CLOD HOPPER



Division of Velocidad, Inc.

FIBERFAB

2365 LAFAYETTE, SANTA CLARA, CALIFORNIA 95050

CLODHOPPER ASSEMBLY INSTRUCTIONS

Table of Contents

1. INTRODUCTION	1
2. ACQUIRING A VW FLOORPAN	2
3. REMOVING THE VW BODY	3
4. PREPARING/SHORTENING THE FLOORPAN	6
5. MOUNTING THE CLODHOPPER ON THE 'PAN	8
6. WIRING, ETC.	11
7. CORVAIR POWER?	15

1. INTRODUCTION

The Clodhopper is Fiberfab's entry in the ever-expanding array of fiberglass bodies for shortened Volkswagen chassis. The Clodhopper is manufactured -- as are all Fiberfab products -- from the highest quality glass fiber, polyester resin and gel-coats that are commercially available. In addition to this high quality you will note; when you receive your Clodhopper, several unique design features -- richly and permanently textured interior surfaces; integral, heavily-reinforced battery wells; one-piece hood and dashboard; etc. -- which places it a notch above the competition and assures you that your Clodhopper is the "best buy" in the fun-vehicle market.

The Clodhopper is very easily assembled onto a shortened VW floorpan. The instructions deal with all aspects of your Clodhopper construction project with emphasis on floorpan preparation and shortening -- the shortening being the "toughest" part of the project. If you're doing the shortening you'll need an oxy-acetylene welding/cutting outfit. If you're not, the following inventory of tools and supplies should suffice:

HAND TOOLS

5/16", 3/8", 7/16", 1/2", 9/16", 5/8" sockets (3/8" - drive)
and/or open-end wrenches of the same size.

3/8" - drive ratchet handle

Standard screw-driver -- medium blade

Phillips screw-driver -- medium blade

Straight-edge

Steel tape (72")

Assorted rasps, files and drills

Woodworking hole saws
2" (for steering column cutout)
4 1/4" (for speedometer cutout)

Wire terminal crimping tool

Pop rivet gun -- home workshop variety

POWER TOOLS

1/4" capacity electric drill

(Sabre saw and 1/2" capacity electric drill are helpful.)

MATERIALS

2 doz. American Standard, round head, square neck, step bolts, 5/16" - 18,
1 1/4" long with nuts, washers and lockwashers.

Assorted machine bolts, nuts, washers and lockwashers; 1/4", 5/16" and
3/8" various lengths 1" to 3".

Assorted heavy-gauge, sheet metal screws

Pop rivets, assorted lengths, 1/4" to 1/2"

Quart of rust-inhibiting paint

2. ACQUIRING A VOLKSWAGEN FLOORPAN

Many persons purchasing a Clodhopper body kit wish to replace the travel-worn shell of the "beetle" they already own. Other builders plan to acquire a wrecked Volkswagen from a salvage yard and refurbish this "out-cast" with a new Clodhopper body and perhaps a few "fresh" mechanical parts. In either instance, this brief section should be of interest to all prospective builders.

For our purposes, the "Volkswagen family" can be divided into four groups: 1) Pre-1960 beetle, 2) Post-1961 beetle, 3) Variant, 4) Karmann-Ghia. The Variant and Ghia are not suitable for use as chassis for a Clodhopper. The earlier beetles are all 36 horsepower and employ a 4-speed, non-synchromesh gearbox. The later cars (engine numbers starting at 5,000,001) all have least 40-horsepower and all employ a 4-speed, synchromesh gearbox. All the beetles are suitable, but the later models are preferred.

In the locale of Fiberfab -- the San Francisco Bay Area -- reputable automobile dismantlers are listed in a publication called the PARTS LOCATOR. The PARTS LOCATOR is issued monthly and contains extensive lists of all wrecked automobiles in yards throughout Northern California. Most likely, similar publications exist in your area and would assist you significantly if you choose to utilize used parts. For your reference, the PARTS LOCATOR address is: PARTS LOCATOR, 1696 Washington Avenue, San Leandro, California, 94577.

When browsing through the wrecking yards, remember that what you need consists of four major pieces:

1. Floorpan -- the VW "platform frame"
2. Front suspension/steering unit including the steering column
3. Transaxle -- gearbox, differential and axles
4. Engine

You can buy all four pieces in one wreck or buy them separately (perhaps part from a dismantler and part from a component rebuilder). Some minor compatibility problems arise when pre-1960 and post-1960 parts are pieced together, but these can generally be solved with little difficulty.

Many bits and pieces of VW hardware can also be used to finish your Clodhopper; e.g.; windshield wiper motor assembly; gauges; ignition, headlight and dimmer switches; wheels (unless special wheels are going to be used); gas tank (1961 or later); weatherstripping; etc.

It is extremely difficult to estimate prices for the required Volkswagen components as they vary considerably across the country. We have seen 1954-1958 Volkswagen chassis sell for \$25-\$50, complete and running (not well, but running). 1958-60 floorpans with running gear sell for \$100-\$250. Complete post-1960 wrecks run from \$200 to \$650 depending upon age and condition. Sources of Volkswagen parts other than wrecking yards are sometimes cheaper (e.g., tips from your automobile insurance broker concerning VW "totals", local newspaper used car ads and VW repair shops are other potential sources of the parts you need).

Unless you are equipped with metric and special VW tools (and like to tinker with engines and transaxles) it is probably advisable to invest a little more in a low-mileage wreck. In any case, when buying a chassis with engine (or an engine alone), have the seller run the engine before you complete the purchase.

Always keep in mind that, if the four items listed above are intact, the wreck is usable -- DON'T LET A MANGLED BODY FOOL YOU!

3. REMOVING A VW FLOORPAN

If you acquired a wrecked Volkswagen without the body, you can skip this section. If not, read on!

Before the VW body can be separated from the floorpan the following tasks must be completed:

1. Remove the front and rear seats
2. Remove loose carpeting and floor mats
3. Disconnect and remove the battery
4. Drain the gas tank and disconnect the gas lines
5. Remove the gas tank
6. Separate the hydraulic fluid reservoir from the body
7. Disconnect all electrical wiring from the engine (e.g., coil, electric choke, etc.)
The wiring harness can be extracted from the body and used as a source of wire.
8. Remove the left front wheel.
9. Unbolt steering shaft retainer
10. Unbolt the steering column clamp at the dashboard
11. Remove the steering column assembly

Now you are ready to unbolt and remove the Volkswagen body. Referring to Figure 1 -- remove the body retaining bolts at the locations shown. Side bolts are accessible under the edge of the body and rear bolts are accessible from within the body (carpet lifted). The body is now free of the floorpan and can be lifted-off using a block and tackle, chain hoist, or yourself and several "strong and willing" helpers. The VW body is extremely heavy and considerable care should be exercised when removing it. It is because of this weight loss, incidentally, that you can expect considerably better-than-Volkswagen performance from your completed Clodhopper.

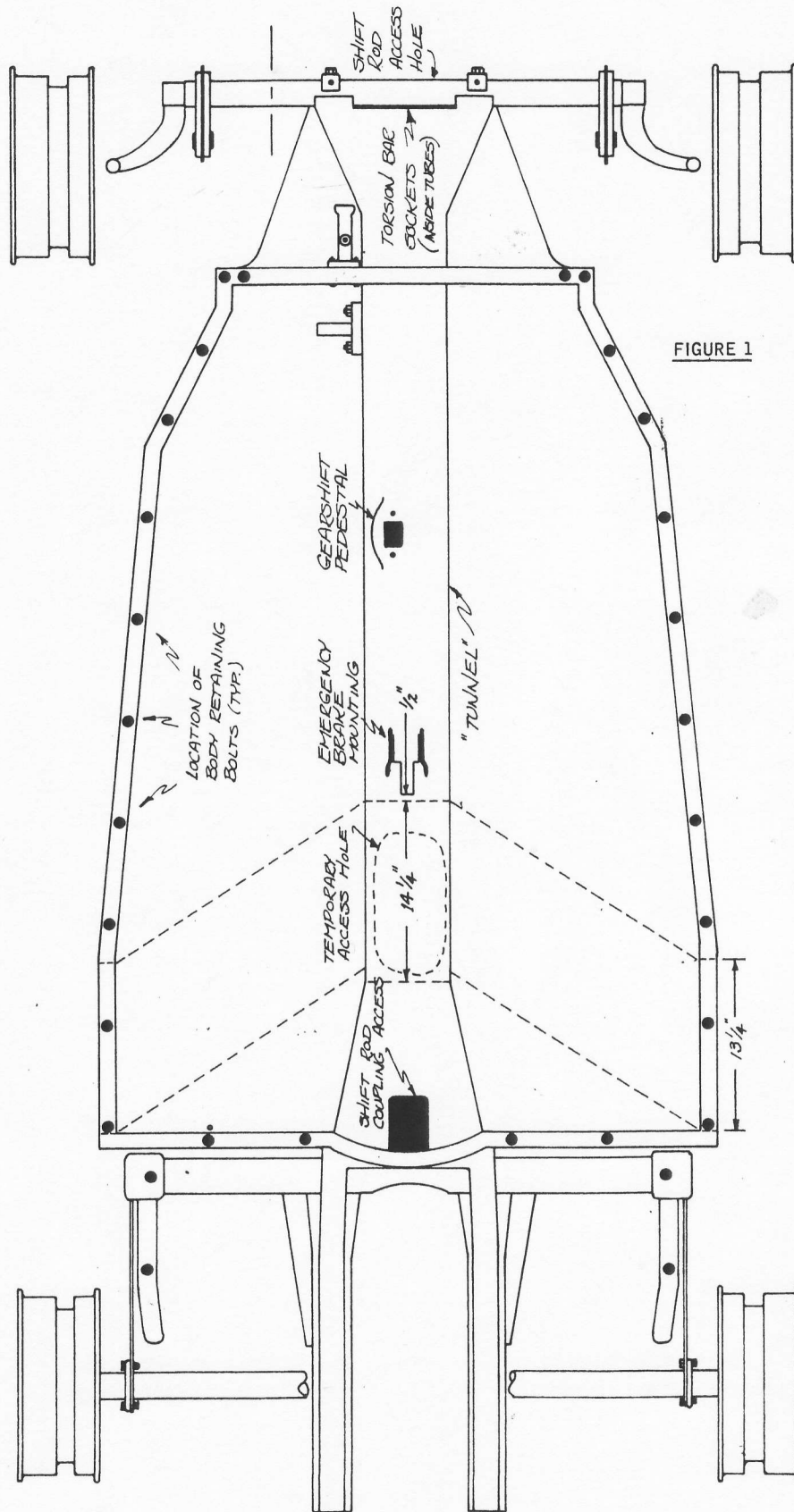


FIGURE 1

4. PREPARING/SHORTENING THE FLOORPAN

Most "dune buggies" are vehicles having, nominally, 80" wheelbases (distance from the center of the front wheels to the center of the rear wheels). VW's have 94.5" wheelbases. Therefore the VW floorpan must be shortened about 14" to accommodate the Clodhopper body. In addition to shortening, the 'pan should be cleaned, the rear wheels should be decambered, and the front suspension "softened" before the Clodhopper body is secured to it.

The general clean-up should clear the floorpan of bits and pieces of torn floor covering and weatherstripping. Stones, broken glass, etc. should be vacuumed or swept off. Rust spots should be sanded to bare metal and covered with a rust inhibiting paint or primer -- special attention should be given the area surrounding the VW battery tray where battery acid may have spilled. Any holes in the 'pan should be plugged or patched.

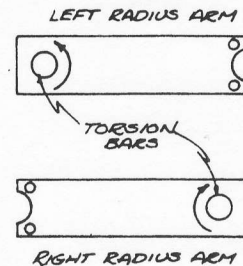
The next step in preparing the floorpan is decambering the VW rear suspension. Decambering is required to compensate for the reduction in sprung-weight caused by the replacement of the VW steel body with the Clodhopper fiberglass body. Without decambering your Clodhopper will ride several inches too high in the rear. Decambering is usually not required if Corvair-power is planned.

Decambering is accomplished by disengaging the torsion bar, including radius arm (referred to by VW as "spring-plate"), from the splines at the center of the floorpan, i.e., pull-out the bar and radius arm. Now rotate the bar and radius arm, as shown in Figure 2, several "notches" and re-engage the bar in the splines. After both bars have been rotated equivalently, the setting is checked by rolling the floorpan on wheels, back and forth with two people standing on the rear of the 'pan -- the rear wheels should be vertical when the torsion bars are set properly.*

up one on outside spline
down one on inside spline

To decamber, pull out torsion bars and radius arms and rotate as shown.

FIGURE 2



Front-end lowering can be accomplished by removing the front torsion bars -- rectangular bars composed of six or more strips of steel -- and disabling, by cutting, half the strips in each bar (cut both sides of both bars -- upper and lower). Another method of halving the front-end spring-rate is to drill through the torsion bar housings -- drill through one socket only (see Figure 1). The torsion bar running through the drilled socket will now act as an anti-sway bar and the "original-equipment" anti-sway bar can be removed. Drilling is performed with a 1" drill-bit secured to the end of a 3-foot extension.

Referring first to Figure 1 -- floorpan shortening is accomplished by cutting-out the piece between the dotted lines and rejoining the two pieces of the 'pan as shown in Figure 3. To begin, remove the gearshift from the gearshift pedestal. Next, uncouple the shifting rod from the transaxle -- see Figure 1 for coupling access. Remove the shifting rod through the access hole at the front of the 'pan. Scribe a 15" line on the shifting rod parallel to the axis of the rod. Remove a 14 1/4" section of the rod such that 3/8" of the scribed line appears on the two pieces remaining. Join these two pieces, by welding, with the two scribed lines aligned.

*The decambering operation can be hastened considerably by using a Fiberfab Camber Set. The Camber Set is easily installed and provides continuous adjustment of camber without requiring removal of the torsion bars.

Now, cut a temporary access hole in the top of the "tunnel". Start the hole about 4 " behind the emergency brake mounting and cut as shown in Figure 1. Bend the tubes running inside the tunnel away from the sides of the tunnel so that they will not be damaged during the subsequent cutting operation. Break the retaining welds securing these tubes to the tunnel behind the emergency brake mounting -- break all welds including those at the points where the tubes exit the rear of the tunnel. Move the brake line, running outside the tunnel on the floor, away from the side of the tunnel.

Mark the floorpan with chalk and cut as shown in Figure 1. Use an oxy-acetylene torch or a sabre saw. Remove the cut-out section by withdrawing it over the ends of the tubes. Reinsert the tubes in the holes in the rear section of the tunnel and move the front and rear pieces of the 'pan together as shown in Figure 3. Check dimensions "X" (X is approximately 54 1/2") to see that they equal. Now weld the shortened 'pan together. Reweld the tube to the end of the tunnel and cut off the excess. Install the shortened shift rod. Shorten the various cables using cable splices or by having new ends swaged-on after cutting-out 14 1/4". Coil the excess brake and gas lines.

With the cleaning, sanding, patching, shortening, etc. completed the floorpan need only be painted with a rust-inhibiting paint to make it ready for the Clodhopper body.

-7-

5. MOUNTING THE CLODHOPPER ON THE 'PAN

The Clodhopper body mounts directly to the shortened floorpan. The original VW body-to-pan weather strip can be used, if available. Bolt the body to the 'pan using 8 step-bolts per side, passed through the original body mounting holes in the 'pan and 5/16" holes drilled in the mounting lip of the body. Heavy-gauge sheet metal screws should be used to secure the body to the 'pan along the front and rear mounting lip -- put washers under the screw heads. General placement of the body is shown in Figure 4.

Figure 5 shows the mounting of other components in the Clodhopper body. The gas tank is placed in the pre-formed well in the nose of the body and secured using stock-VW gas tank hold-down clamps. Headlights are mounted on the molded-in pedestals on the body -- the recommended lamps are manufactured by:

R. E. Dietz Company
225 Wilkinson Street
Syracuse, New York 13201

and carry part numbers 820-B and 820-C for black and chrome units, respectively.

The windshield provided with the Clodhopper kit is bolted to the sides of the hood with the vertical portion of the frame parallel to the face of the dashboard. Place the weather strip, provided with the windshield, between the frame and the top of the dashboard. The windshield is secured to the hood, as shown in Figure 5, with 5/16" hardware -- the best appearance is gained using plated, flat-head (or filister head) machine bolts. With the frame in position drill through the frame and sides of the dash with a 5/16" drill -- countersink the holes if flat-head bolts are to be used. *

To fit the steering column, bore a 1-3/4" hole in the firewall 10" from the center of the body and 4" down from the top of the firewall. Pass the column through the hole and secure the steering shaft to the universal-joint on the steering box. Support the column temporarily until the hood is secured to the body.

Mount the windshield wiper motor in the hood by drilling through the pair of mounting bosses with a 7/16" drill. Place the wiper shaft bushings through the holes and secure with stock hardware. Added support for the wiper assembly can be provided with a bracket mounted on the lower lip of the dashboard.

The brake fluid reservoir can be mounted on the forward side of the "firewall" using a standard 3" hose clamp affixed to the fiberglass using pop rivets or small machine bolts and nuts.

After boring a hole in the hood to accommodate the gas tank filler place the hood in position on the body and secure with pop rivets, sheet metal screws or #10 machine bolts. Drill the body and hood, to accept the fasteners, as shown in Figure 5. Now lift the steering column to the lower surface of the dashboard and attach it using stock VW hardware (U-clamp and rubber grommet).

On to the wiring.....

* see page 15 for the precise location of the windshield if a soft top is to be installed

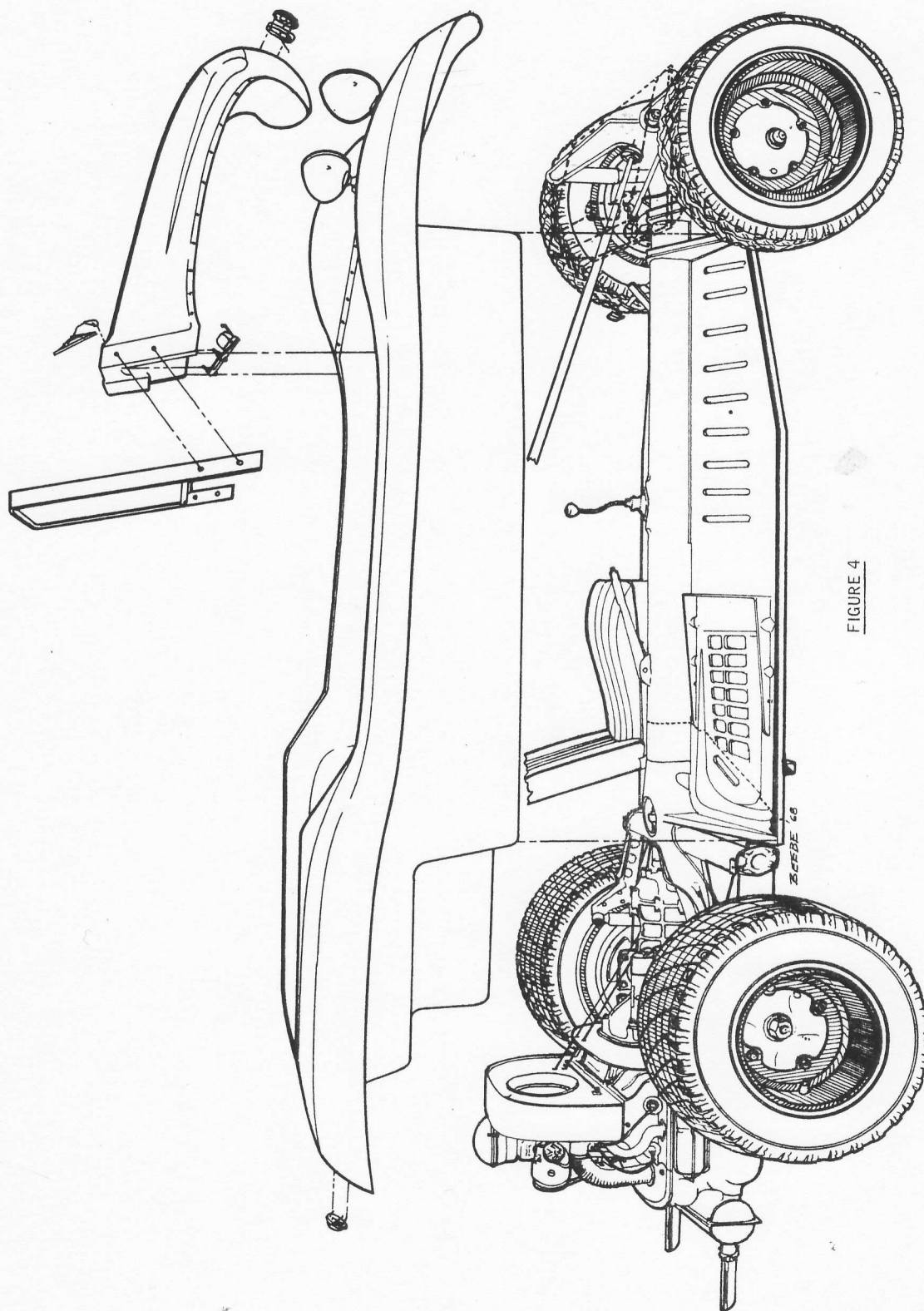


FIGURE 4

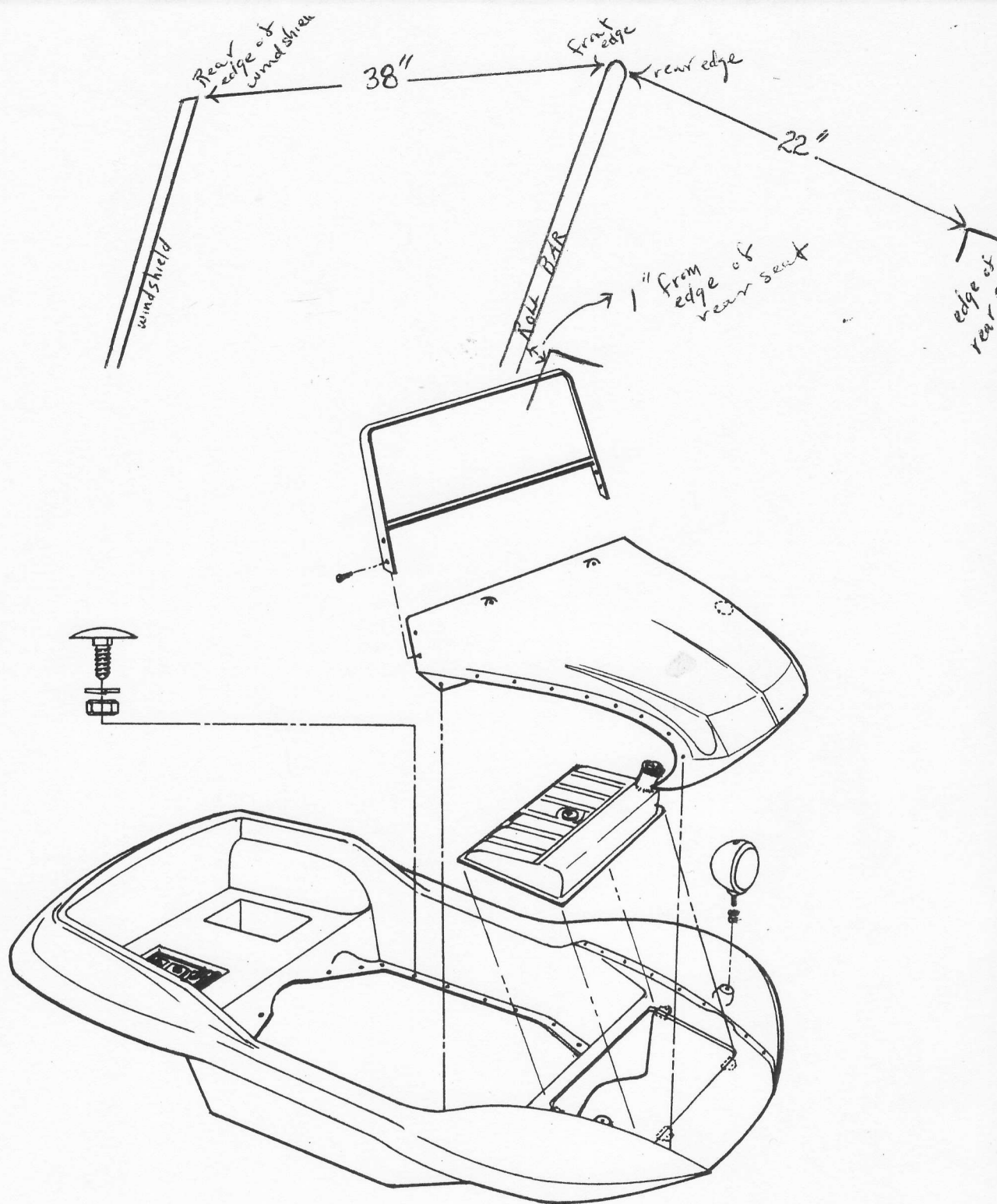


FIGURE 5

Speedometer
Dash Gauge Hole
4 11/16" + "

Wiper arms
1964 VW
Bus

6. WIRING, ETC.

This section of the instructions provides the ground-rules for completing the basic wiring of your Clodhopper body. The configuration described below is based on the factory-assembled wiring system, or "harness", which has proven the most adaptable to the widest variety of engine/instrumentation/lighting combinations. The factory prepared harnesses are available, as part of the Clodhopper Wiring Kit, from Fiberfab at extra cost.

To begin, a wiring harness should provide for the following:

1. Engine starting
2. Engine ignition
3. Instrumentation -- engine oil pressure, fuel level, battery/generator condition, etc.
4. Interior lighting -- dashboard lights, etc.
5. Exterior lighting -- headlights, taillights, etc.

At this stage in the construction of your Clodhopper, many items to be wired have been installed, viz., the starter, starter solenoid, ignition coil, generator, voltage regulator, fuel level sender, oil pressure switch and headlights. The items in the list below, however, are yet to be installed. Additionally, this list contains remarks concerning mounting methods and locations of these to-be-installed items plus recommended sources --

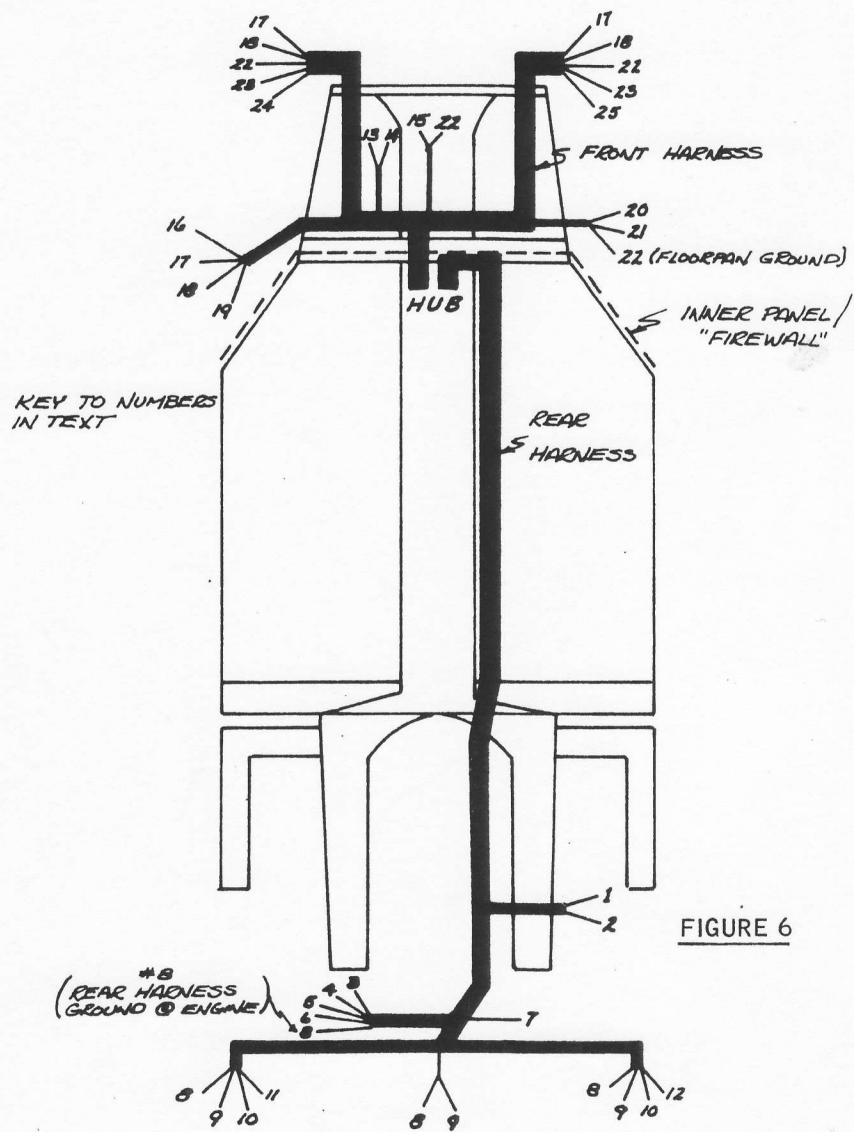
1. **TAIL LIGHT/BRAKE LIGHTS:** On the rear deck lip wherever a pleasing appearance is gained -- Corvette Stingray, '65 Chevrolet or VW to name a few.
2. **FRONT PARKING/TURN INDICATOR LIGHTS:** On top of the front fenders near the headlights or on each side of the front license plate -- e.g., late model VW/Karmann Ghia.
3. **WINDSHIELD WIPER MOTOR:** Standard VW windshield wiper motor and mechanism installed conventionally using the molded-in mounting bosses in the Clodhopper hood.
4. **DIMMER SWITCH:** On the "firewall" just to the left of the clutch pedal -- factory-built cars all employ Ford switches but any dimmer unit should operate successfully.
5. **HORN:** On the outside of the "firewall" near the lower right hand corner -- use a VW horn.
6. **FUSE BLOCK:** On the inside of the "firewall" above the center of the floorpan brace -- factory-built cars use blocks having a capacity of four fuses:
 - A. Headlights, parking lights, taillights
 - B. Brake lights
 - C. Turn indicators
 - D. Horn, windshield wiper motor, instruments, accessories, etc.

The fuse block is part of the Wiring Kit. Fuse blocks may be assembled using fuse holders available from a local electronics parts store (e.g., part number 57 E 3006 as listed in the Allied Electronics catalog for 1968).

7. **BATTERY:** In the right-hand box molded into the rear seat of the Clodhopper body. Bore holes in the sides of the box through which to pass the cables.

Although stock Volkswagen instruments can be used, many of our customers prefer to use a more extensive set of gauges in their new Clodhopper. The VDO gauges used in factory-built vehicles are given in the **OPTION LIST** appended to these instructions. The gauges in the **OPTION LIST** may be ordered from your local VDO dealer or directly from Fiberfab.

The wiring harness is divided into two major sections -- hub-to-rear and hub-to-front -- where the instrument panel is considered to be the "hub" of the wiring. Figure 6 shows the general routing of these harnesses relative to the shortened Volkswagen floorpan. The hub-to-front harness is routed through the "firewall" just under the fuel tank-mounting surface. At this point the harness divides in a "T". The left-hand portion of the harness is brought to the left edge of the tank-mounting surface where it again branches with one branch running forward along the side of the gas tank to the headlights and parking lights. The other branch is routed back along the firewall to the dimmer switch. The right-hand portion is routed in the same manner as the left to the right headlight and parking light.



The hub-to-rear harness is brought down the inside surface of the firewall to the floor and then back along the joint between the floor and central "tunnel" -- along the right side of the tunnel. It is passed through the body just above the mounting lip at the base of the rear seat and from there it is extended to the starter, rear lights and engine.

Referring to the numbers shown in Figure 6, the wires in the harnesses terminate as follows:

REAR HARNESS

1. Starter motor primary -- electrical system primary "hot" lead (8)* F**.
2. Starter solenoid (14) F.
3. Spare (14) F.
4. Spare (16) F.
5. Ignition coil "BAT" terminal (14) F.
6. Oil Pressure switch (16) F. (warning light power)
7. Voltage regulator "61" terminal (16) F. (warning light power)
8. Lighting ground (14) B. (wire in cluster with 3,4,5,6 is grounded to engine)
9. Tail light(s) (14) F.
10. Brake light(s) (14) F.
11. Left turn light (14) F.
12. Right turn light (14) F.

FRONT HARNESS

13. Brake light switch power (14) F. (to one terminal of the pressure switch mounted in the end of the brake master cylinder)
14. Brake light switch return (14) T. (to the other pressure switch terminal)
15. Fuel tank send (16) T.
16. Headlight power (10) F. (to dimmer switch)
17. High beam power (12) A.
18. Low beam power (12) A.
19. High beam indicator light power (16) T. (terminated in the same terminal as wire #17)
20. Horn operating (ground) wire (14) F.
21. Horn Power (14) F.
22. Front end ground (14) A (12) T.
23. Parking light(s) (14) F.
24. Left turn light (14) F.
25. Right turn light (14) F.

All wires lead to or from the hub with the exception of the rear harness ground (wire #8), low beam power (# 18) and high beam power (#17). The wiring of the hub, and the connection of the harnesses to it, is diagrammed in Figure 7. The diagram in Figure 7 is based on the use of VW instrumentation (viz., speedometer, ignition switch, headlight switch, windshield wiper switch, fuel gauge and 3-wire turn signal switch). The terminal block and fuse block are included in the wiring kit (e.g., 47 E 1876 and 57 E 3006 as listed in the Allied Electronics catalog for 1968).

* numbers in parentheses refer to recommended wire sizes

**F = from hub, T = to hub, A = ahead in harness, B = back in harness

FINISHING TOUCHES FOR YOUR CLODHOPPER

Upholstering your Clodhopper can be accomplished using part or all of the materials listed in the OPTION LIST. The principal item of upholstery is the carpet -- "stock" VW front seats can be used and the rear seat space need only be covered with a piece of plywood forming a "minimum" seat.

The materials required to carpet your Clodhopper are:

1. 4 yds. automotive carpetting (36" wide)
2. 4 yds. carpet jute for padding
3. 10 yds. vinyl carpet-binding
4. 1 spray can of trim adhesive

Use heavy kraft paper to make patterns of the floor area. Transfer the patterns to the carpet (making sure it is not upside-down) and cut. Sew on the binding. Cut the jute to match the carpetting. Spray the floor with trim adhesive and install the jute. Then spray the jute and install the carpetting over it.

Other items to be considered for interior finishing include ashtrays (mounted in the dashboard), grab-bars, scuff-plates on the "door" sills, etc., etc., etc. Let your imagination be your guide.

If you decide to use the Fiberfab soft-top on your Clodhopper, Figures 8 and 9 show how this top is installed. Referring to these figures -- the top-bows are assembled with the small bow to the rear. The tops of the bows should be parallel. Install the mounting brackets, as shown, with #10 self-tapping screws.

Check the position of the top of the windshield by measuring from the center top edge of the rear seat to the center front edge of the windshield. This measurement should be 60 inches. If this dimension is more or less than 60 inches the top will not fit or will fit improperly.

If all measurements check, center the top on the bows and drill through the seams in the top into the bows and secure the top to the bows with chrome-washered screws. Tuck the front flap of the top into the groove in the windshield frame and pull the top rearward until it is taut. Then, starting at the center snap, mark the body to locate the snap-stud. Drill the body and install the stud. Work out from the center repeating the locating-and-drilling process until all the snaps are affixed to snap-studs. Finally, pull the top smoothly over the windshield frame and locate, drill and install the front snap-studs.

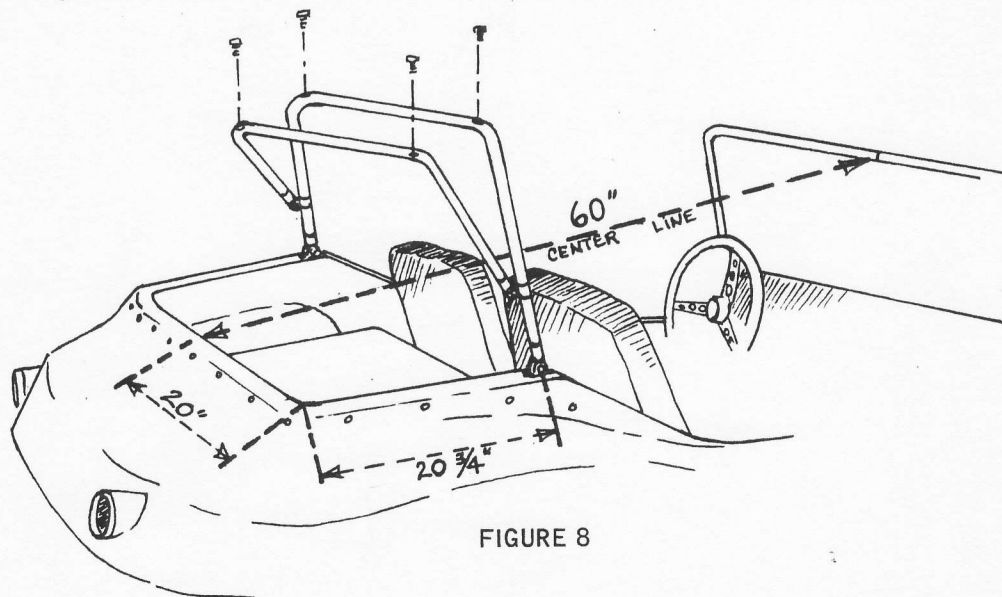


FIGURE 8

Chrome-washered screws

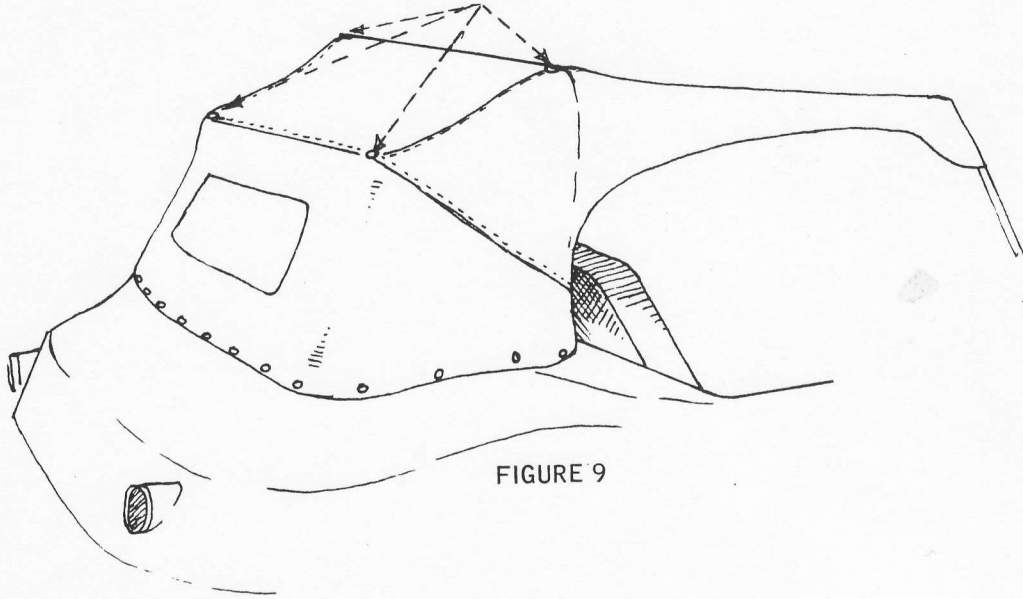


FIGURE 9

7. CORVAIR POWER

For more "GO" from your Clodhopper, the Volkswagen engine is readily replaced with a much more powerful Corvair engine. Good Corvair engines 1962 or later, are available at most wrecking yards for \$100.00 to \$300.00, depending on year and condition. Avoid the turbo-charged engines.

It is not necessary to decamber the Volkswagen floorpan if Corvair power is used as the added weight of the Corvair engine compensates for the Volkswagen camber.

Take the Volkswagen transaxle to a VW shop and have them put the ring gear on the other side of the case (the direction of rotation of the Corvair engine opposes that of the VW). The ring gear "flop over" should not be attempted by one unfamiliar with setting up automotive rear ends.

Next, the bell-housing is removed from the Corvair engine in preparation for mounting a Corvair-to-Volkswagen adapter plate. With regard to adapters -- we strongly recommend the use of the adapter kits produced by Crown Manufacturing Company, 651 West Seventeenth Street, Costa Mesa, California. The Crown Adapter Kit includes:

- No. 5001 Engine Adapter
- No. 5002 Starter Adapter
- No. 5003 Heavy-duty Flywheel Plate
- No. 5004 Heavy-duty Pressure Plate
- No. 5005 Clutch Disc
- No. 5008 Universal Throttle Linkage

Crown also manufactures a number of accessory items such as muffler-exhaust systems which can be used for your Corvair powered Clodhopper. Further information is available from Crown Manufacturing. It will be helpful when you write, if you mention that the kit is to be used with a Fiberfab body.

After the bell-housing is removed, remove the Corvair pilot bearing in the end of the crankshaft and replace with the extended-type supplied by Crown -- the original bearing has the proper ID but does not engage enough of the Volkswagen transmission input shaft. Bolt the adapter plate to the Corvair (if the oil seal is not yet installed in your adapter plate, make sure that when you do install it you refer to the original Corvair bell-housing to avoid placing it in backwards). Next, bolt the adapted flywheel to the Corvair crankshaft and then bolt the clutch plate cover (with clutch disc in place) to the flywheel.

Drive the starter-motor-shaft bushing out of the VW transaxle and replace with the special bushing in the Starter Adapter kit. Now bolt the Corvair to the Volkswagen transaxle--interference between the transaxle and the engine heater duct is eliminated by reshaping the ducts or replacing them with Crown #5012 Heater Adapters. The Corvair starter is used by means of the starter adapter.

To complete the engine installation, the Volkswagen throttle wire is coupled to the Corvair via the Universal Throttle Linkage and a suitable exhaust system is installed (e.g., Crown #5010).

Using the Corvair engine, the electrical system becomes 12-volt instead of the Volkswagen 6-volt. The wiring harnesses described in Section 6 are, however, still applicable. All bulbs gauges, gauge sender units etc. must be 12-volt units -- or -- 6-volt units with series voltage dropping resistors.

CLODHOPPER OPTION LIST

Two-tone solid color or Metal-flake finish	\$ 50.00	
Convertible vinyl top (white or black)	75.00	- 60.00
Hardtop (black, vinyl-textured)	89.00	
Show-bar (roll bar for looks)	29.95	
Go-bar (roll bar for maximum safety)	59.95	23.00
Carpets (black only), set	35.00	
Front seat covers (black vented-vinyl), pair	45.00	
Rear seat (cushion and back rest), set	45.00	
Economy side curtains, pair	45.00	
Deluxe side curtains (with frame), pair	100.00	- 60.00
Boot for top	25.00	

Wiring Harness (6 or 12 volt), complete kit 39.50

6 VOLT INSTRUMENTS, COMPLETE SET BY VDO

<u>VDO No.</u>	<u>Description</u>	<u>List Price</u>
De 3501	Oil pressure gauge	\$ 10.97
De 3601	Oil pressure sender	12.30
Fe 3213	Oil temperature gauge	13.92
Fe 3272	Oil temperature sender	6.78
Fu 3001	Fuel level gauge	13.68
Tf 2251	Tank Installation Kit	2.52
Tf 2201	Tank Unit	14.22
Am 1903	Ammeter	6.25
Va 0002	Vacuum gauge	13.07
-	Vacuum gauge installation kit - 12 ft.	5.30
Sp 1222	Speedometer (764 rev/mile)	23.05
-	VW-to-VDO speedometer cable - 6 ft.	2.80
68/4/1	Tachometer (4 cyl.)	44.85

12 VOLT INSTRUMENTS, COMPLETE SET BY VDO

<u>VDO No.</u>	<u>Description</u>	<u>List Price</u>
De 3502	Oil pressure gauge	\$ 10.97
De 3603	Oil pressure sender	14.40
Fe 3216	Oil temperature gauge	16.75
Fe 3273	Oil temperature sender	6.78
Fu 3002	Fuel level gauge	13.68
Tf 2201	Tank unit	14.22
Tf 2251	Tank installation unit	2.52
Am 1903	Ammeter	6.25
Va 0002	Vacuum gauge	13.07
-	Vacuum gauge installation kit - 12 ft.	5.30
Sp 1222	Speedometer (764 rev/mile)	23.05
-	VW-to-VDO speedometer cable - 6 ft.	2.80
28/5/1	Tachometer (6 cyl.)	44.85

DECAMBERING THE REAR WHEELS

Gene Rideout, Bellingham, Wash., reports that after driving his Porsche about 20,000 miles, mostly with just himself in the car, it developed a port list; we don't know his weight, but unusual angles have developed on other cars at about the same mileage. Gene got out his shop manual and raised the left rear of his car one degree and lowered the right rear one degree, and reports things are back on an even keel.

The operation on the rear torsion bars can be done by almost anyone who can turn a wrench provided some guidance is available. John Snyder, Potomac Region, conducted some adjustment on his rear torsion bars and wrote up the details and explained a few technical points as he went along. Our only preface to John's article is that you should not play around with the torsion bars just because you have nothing else to do on a Sunday afternoon. We suggest that if you know there is a list, a droop snoot, or you want the rear end to hold in competition, then go ahead and do the job. Well equipped VW and Porsche shops have a plumb bob (VW tool 245A), that will accurately measure the angle on the rear radius arms. The radius arm (which is attached to the end of the rear torsion bar) when hanging free, should have an angle of from $6\frac{1}{2}^{\circ}$ to 7° down from the horizontal.

Many Porsche owners have experienced the tendency of their car to oversteer, that is, to follow a path of progressively decreasing radius in any one given turning position of the steering wheel, requiring the driver to "open up" on the steering wheel in order to steer around a curve of constant radius. Many have also experienced the tendency of the car to "wander" at higher speeds, particularly under the influence of a crosswind. These conditions may in large part, and in many case, be completely overcome by decambering the rear wheels.

The degree of camber of the rear wheels is that degree to which the rear wheels are tilted outwardly so that their upper portions are displaced outwardly of the road contacting portions. When the rear wheels are perfectly vertical, they are said to have zero camber. Because of the manner in which the rear wheels of the Porsche are independently suspended, lowering of the rear end of the car with respect to the rear wheels produces negative camber. Although the suspension geometry of the car may be perfectly proper when new, the front torsion bars apparently have a greater tendency to be permanently deformed than do the rear torsion bars so that after prolonged use, the front end of the car may be lower to the ground than it originally was, whereas the rear end may be at substantially its original height, causing the car to have a nosed down appearance. It is in such cases that the above-mentioned oversteering tendency and lack of directional stability are most noticeable. If you have the

lost, go out and buy a new pair of front torsion springs. If not, read the rest of this article, although a slight decambering of the rear wheels even in a new car may be quite rewarding.

The effect of decambering on the oversteering tendency is rather technical and need not concern us here, suffice it to say that decambering the rear wheels of a Porsche, whether the car be new or used, has a pronounced effect on the oversteering tendency and will decrease it in all cases, causing the car to have more or less a neutral steering tendency. The incidental effect of decambering which causes the car to have greater directional stability is easily understandable when it is realized that decambering the rear wheels lowers the rear end of the car and that lowering the rear end of the car will tend to create a greater degree of caster of the front wheels, caster in this case being the amount that the kingpins are tilted toward the rear of the car at their upper ends. The greater the degree of caster, the greater tendency for the front wheels to remain in or return to the straight-ahead position, hence greater directional stability. Another factor contributing to directional stability is the proper amount of toe in of the front wheels, which is, of course, a requirement under any circumstances.

The writer's automobile, a 1953 coupe, possessed a great tendency to oversteer, a pronounced degree of directional instability, and also a tendency to shimmy. All of these faults were corrected by decambering the rear wheels. The fact that the shimmying disappeared shows that there was too little front wheel caster before decambering the rear wheels, since the front end in all other respects was in good shape.

Decambering the rear wheels is a rather simple job, although perhaps an hour to an hour and a half should be allowed. The first step is to jack up the car and remove one of the rear wheels. Then remove the three sets of nuts and bolts which connect the bifurcated rear end of the trailing arm to the axle housing, two of the nuts and bolts also serving to attach the shock absorber lower bracket to the axle housing. In the writer's car, these nuts and bolts fitted a 19 mm. wrench, although a $\frac{3}{4}$ " socket was also used to good advantage. The trailing arm is a length of metal about 5" wide and about $\frac{1}{8}$ " or $\frac{3}{16}$ " thick, and which extends forwardly of the rear axle housing for pivotal connection to the frame. With these three nuts and bolts removed, pull the rear axle housing rearwardly so as to leave the rear end of the trailing arm free. To do this, it may be necessary to loosen the clamp on the axle housing which serves as an anchor for the flexible brake hose and to move this clamp slightly outwardly to prevent it from striking the heat exchanger for the heater and permit the rear axle housing to be moved back

a sufficient distance to clear the forked rear end of the trailing arm.

With the trailing arm thus freed, it will probably be in such a position that its lower edge is engaged against the stop on the frame just rearwardly of the point at which the trailing arm is connected to its rear torsion bar. It should be noted at this point that the optimum position of the trailing arm will probably be such that when free, its lower edge will either just clear the stop or be spaced no more than 1/8" above it. Much more spacing than this will probably make it very difficult to remove and replace the rear wheel since there will be insufficient clearance between the brake drum and fender. The next step is to remove the four bolts which secure the dust cover cap for the torsion bar to the frame, either a 17 mm wrench or a 21/32" wrench will do. The dust cap will probably have to be pried off with a screwdriver, since it carries on its inner side a resilient bushing which embraces the outer end of a boss which extends transversely through and is rigidly secured to the forward end of the trailing arm, the fit being rather snug. The boss is hollow and internally splined and receives the splined outer end of the torsion bar. The next step is to pry the trailing arm outwardly so that it pulls off from the outer end of the torsion bar. However, it will probably be best before doing this to mark a vertical line on the outer face of the torsion bar (nail polish will do) so that the original position of the torsion bar can be determined.

There are 44 splines on the outer end of the torsion bar and its inner end is provided with 40 splines. Since rotating the freed trailing arm even one spline with respect to the torsion bar so the rear end of the arm is moved upwardly from its original position and then re-engaging the arm with the torsion bar will effect a considerable degree of lowering of the rear end of the car on that side, it will probably be necessary to manipulate both the inner end of the torsion bar and the outer end to achieve the desired result. This is rather easily accomplished since there are fewer splines on the inner end of the bar than there are on the outer end, and the best manner of proceeding is to disengage the inner end of the bar and rotate it one spline in the direction which would cause raising of the rear end of the arm were it attached to the torsion bar and to then rotate and re-engage the arm one spline from its original position on the bar in a direction which would lower its rear end from its original position, the net effect of these two steps being to just very slightly raise the rear end of the arm when the parts are all reassembled. In other words, on the left rear wheel, the torsion bar is rotated one spline in a counter-clockwise direction, while the arm is rotated one spline in a clockwise direction, and vice versa for the other side of the car. These two

steps should be repeated until the lower edge of the trailing arm just clears or is no more than 1/8" from the stop. Incidentally, when removing the inner end of the torsion bar from its socket, it is best to first remove the rubber bushing which is slipped into the frame and embraces the inner end of the trailing arm boss when the parts are assembled. This makes it easier to grab the torsion bar and exert the necessary pulling force to remove it from its splined socket.

Insofar as the torsion bar is concerned, particular care should be taken not to mar or scratch it and although the splines are not lubricated, there should be a coating of grease throughout the intermediate length of the bar to protect it from rust.

Needless to say, the trailing arm on both sides of the car should be so positioned that both wheels are identically cambered. It should be remembered that even a very slight overall adjustment of the trailing arms will result in very rewarding and noticeable results, so moderation should be the keynote. With the parts reassembled, hop in the car and head for the nearest dirt road, and if you can't take that curve faster and with less rear end sliding, let me know.

WIPER BLADES

The windshields, as well as the windows, in Porsches are made of a special glass which is shatter-proof tho it is not of the sandwich construction which is familiar around Detroit. One of the disadvantages of the Porsche windshield material is that it is somewhat softer than ordinary glass. Some of us have discovered that the metal in the windshield wiper blade holders will scratch the windshield. If this scratching becomes bad enough, many state laws require that the windshield be renewed.

One of our members suggests that if the small rivets, which are used to attach the blade holders to the wiper arms, are kept tight the metal parts cannot tip over far enough to touch the windshield. We tried this on a "tired" blade holder by tapping lightly several times with a small hammer, using a larger hammer as an anvil on the other end of the rivet. This did the trick but we suggest that you be careful the rivet is not so tight that it will prevent free movement of the holder as it passes over the curved surface of the windshield. We also noticed that the wipers did a better job after the rivets were tightened.

WIPERS WORKING?

Eugene Rideout of Bellingham, Washington where it DOES rain, has some good advice about maintaining windshield wiper mechanisms. Gene burned out the motor during the warranty period. When he received a new one, he repacked the gear case with a light grade of Lubri-plate. It worked... no more trouble. This would probably apply to cold weather climates as well as rainy ones.

