MIND TRAIN

PANTERA ACCESSORIES

This price list is a supplement to our regular 3-ringed catalog available for $35. The list is divided into 5 catagories for easy use. More information on specific Mind-Train Exclusives is available upon request. When ordering by mail, please be sure to include phone number and year of car.

MIND-TRAIN EXCLUSIVES

New, Uncomparable, Best-on-the Market, In Stock, Constantly Expanding, Exclusive MIND-TRAIN Enterprises Pantera Stuff

"BIG THROATS" EXHAUST SYSTEM:
The following components make up the most complete exhaust system for the Pantera (or any other car). Our unique and proven design offers maximum performance and variable sound control, all at a reasonable price. Keep in mind that our "Big Throats" were designed not simply as a replacement system, but as a vast improvement over the restrictive stock system. Upgrade your pride and joy with our "Big Throats". . . by far the most popular accessory for the Pantera.

MIND-TRAIN STAGE III HEADERS - The first set of headers good enough to wear our name. Heavy 16-gauge mandrel-bent primary tubes are jig welded to the 3/8" thick flange (no more warpage). Hand formed port matching with special high-port bias for improved flow capacity. Includes manifold and collector gaskets and set of 16 header bolts, collector-flange bolts, nuts, and lockwashers. $175

BIG THROAT TAILPIPE & MUFFLER ASSEMBLY - There are many reasons why our "Big Throats" are the most popular exhaust system for the Pantera. Looks, sound, and unsurpassed quality. Superior design and hence maximum performance. Whether your Pantera is stock or modified, you owe it to yourself to use only the best. Mandrel bent 2½" diameter tubes are jig welded to 14-gauge muffler cases. Chrome tips are either horizontal to ground level (angles) or at an incline (straights). Includes nylon-reinforced muffler hanger, bolts, and instructions.

- Straights - 1971-72 Panteras $200
- Angles - all Panteras $200

256 South Robertson Boulevard. Beverly Hills, CA 90211. (213) 836-4106

"BIG THROATS" EXHAUST SYSTEM (continued):

REMOVABLE RESONATOR INSERTS - Designed to effectively quiet the rumpity-rumpity of our "Big Throats" (if you should so desire), these fiberglass wrapped resonators slip into the chrome tips of our system. Can be inserted and removed at your whim. Set of 4. $ 50

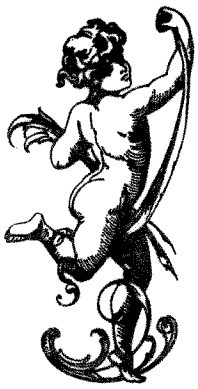
CROSSOVER AND EQUALIZER ASSEMBLY (kit) - Must be welded to "Big Throats" (any competent muffler shop can install easily). Offers state-of-the-art performance by further reducing the backpressure and smoothing out the exhaust pulses. Mid-range performance increase can actually be felt. May be used either with resonator inserts (for maximum noise and resonance reduction) or without inserts (noise reduction with equalizer alone is almost as much as with inserts alone — backpressure, however, is much less with equalizer and no inserts).

The middle section of the crossover tube is surrounded by a muffler-like body. The purpose of the body is to house the special asbestos and fiberglass packing which keeps heat away from the air conditioning condensor. This body also hides the unsightly cross member under the transaxle from view. $50

CHROME EXHAUST TIPS - These show quality chrome tips are the same tips used on our Big Throats. If you need something to cover the rusted stock tips, then these will do the trick. Available in two versions. The weld-on tips will look professional but, of course, involve welding. Our set-screw version features drilled and tapped holes with allen head set-screws and a thin jam nut. Installs in seconds.

- Show Quality - set-screw attachment (set of 4) $ 50
- Show Quality - weld-on attachment (set of 4) $ 40

LEGS (A-ARMS) - If your rear tires are wearing out on the inner edges faster than they are on the outer ones, and normal wheel alignment doesn't solve the problem, then what you need are "the best legs in town". Our exclusive, adjustable, upper A-Arms feature threaded stainless steel ball joints. These joints also allow for as much as 2" wider rear track for fine tuning of handling characteristics.



Our "legs" are available in either high strength 4130 chrome moly (far stronger than stock) or in polished stainless steel. Both versions are precision welded on a jig assuring perfect fit. Included with the set are new steel-cased rubber bushings (for street use) or teflon bushings (recommended for race only). Please specify type of bushings desired.

- 4130 Chrome Moly $280pr
- Stainless Steel $380pr

MIND-TRAIN TURBOS - Now you can have your cake and eat it too! Why should anyone have to give up low-end and mid-range performance (and hence, "streetability") so that they can experience the sheer ecstacy of screaming power in the 4000 to 7000 rpm range? With turbocharging, you can have the BEST of both worlds.

MIND-TRAIN TURBOS (continued):

After over 4 years of development, Mind-Train has the twin-turbo kit most turbo-"plumbers" find so elusive. We've done it and are proud of it. Turn your Pantera into a Starship! We've licked turbo-lag and can custom tailor your kit to give up to 15 lbs. boost without self-destruction. Engineering does make a difference.

Our kit is available in either the basic form or complete form. Either way, you'll never have to weld, cut body panels, nor discard the engine screen. Keep the rear trunk liner in its entirety.

If you already have some of the components in our complete kit, then we'll subtract our selling price of those items from the total.

BASE KIT INCLUDES:

- Twin Rajay Turbos with "Quick-Change" Turbines
- Control Chamber with automatic directional flow gate
- Turbo Headers
- Turbo Tail pipes
- "BigThroats" mufflers

(Cost - $2100)

COMPLETE KIT ALSO INCLUDES:

- Boost Limiters (Set of 4)
- Combination Vacuum Turbo Boost Gauge by Stuart Warner
- Hi-Flow Air Cleaner
- Holly Carburetor
- Edelbrock Aluminum Intake Manifold Modified for Control Chamber Modulation
- "Quick-Change" V-Clamps (Set of 4)
- Hose Clamps (Set of 8)
- Radiator Hose (6 feet)
- Silicon Compressor Hoses (Set of 4)
- Turbo Oil Feed Lines
- Turbo Oil Return Lines (Aeroquip)
- Polished Aluminum Valve Covers Modified for Oil Return Fittings
- Throttle Cable Extensions
- Hurricane Motors/Fans
- Jacobs Computerized C.D.
- All necessary hardware, bolts, and gaskets
- Complete step-by-step instructions

(Cost-$3000)

HURRICANE FAN MOTORS - If your Pantera stays cool on the highway but overheats in stop-and-go traffic, then you need our Hurricane Fans and Motors. These motors develop twice the horsepower of the stock motors and turn our awesome six-blade fans.

When the Pantera is moving normally, there is enough air forced through the radiator by the motion of the car so that the fans are not necessary. At idle or in stop-and-go traffic, however, it is the fans that provide this critical air flow. The stock fan/motor combo is simply inadequate. We are so confident that our "Hurricane" Fans and Motors will solve your overheating problems at idle and stop-and-go traffic that your money will be refunded if they fail to.

Our shroud extension kit includes two Hurricane Motors and two 6-bladed fans attached to machined aluminum hubs with five aluminum bolts and nuts safety-wired in place. Also included are two aluminum shroud extensions that are predrilled for easy attachment to the stock shroud. These extensions are necessary because of the added width of the 6-bladed fans.

Our Tri-Star version gives you two fully assembled, hand-crafted aluminum shrouds with the steering wheel look. The complete assembly is ready to drop into place and plug in.

- Shroud Extension $195
- Tri-Star $295

MIND-TRAIN WINDOW LOUVERS - These hand-crafted custom louvers are aesthetically designed to cover up the unfinished look of the rear window and to bring out the true beauty of the Pantera from ALL angles. The louver sits between the rear wings rather than on top of them.

These louvers are carefully assembled with the use of numerous jigs to insure consistent and non-compromising quality. Each slat is individually aimed and solidly attached with at least 10 rivets. Our louver is supported in the center the full length of the deck lid and on the sides with four quarter-turn quick-release aircraft fasteners. The fasteners are waterproof and allow tilting of the louver for easy cleaning of the deck lid. We also provide a support rod and extra rubber-footed dummy feet to be used when washing the car.

Thorough and beautiful. A bargain at $545 when others are available for $150.

- Unpainted $495
- Painted $545

EUROPEAN STYLE CARPETS - European style and comfort that will transform your Pantera into a true G.T. car. You will enjoy luxurious thick pile carpeting better than found in any car. Designed for use in pent-house suites, this interior package is available in your choice of twenty custom colors. $200

EXTERIOR ACCESSORIES

FENDER FLARES (Hand Laminated) - These flares are the same ones found on the GTS. Pop riveted for easy installation. Gives your Pantera the race-bred look. $150set

FRONT SPOILER - Constructed of high quality foam-filled fiberglass sandwich material. This spoiler improves high speed stability and improves cooling at speed.

- early model (1971-1972) $235
- late model (1972L-on) $235

FRONT AIR DAM - Add to the already excellent handling and front-end stability of your Pantera with this dynamically styled Air Dam. Race-bred design adds that "competition" flair, as well as strength capable of functioning in speeds in excess of 150 mph. Strong multi-ply fiberglass Air Dams are finished in gloss black to contrast with most cars, however, they may be painted to match your car.

- early model (1971-1972) $100
- late model (1972L-on) $100

FRONT BUMPER GUARD - Provides extra protection for the front of your Pantera. Designed to blend perfectly with the car's natural lines, the heavy gauge chromed steel tubing installs easily in minutes.

- early model only (1971-1972) $ 40

PANTERA BRA - Custom made to protect the fine finish from flying stones, stains, and road tar. Thick, resilient black Naugahyde features a soft, cling backing to prevent chafing. Tailored for the Pantera, the Bra is fitted by easy-to-use fasteners which do not require any drilling and are secure at speeds in excess of 100 mph.

- early model (1971-1972) $ 70
- late model (1972L-on) $ 70

CUSTOM RACING STRIPES - Adds a dashing final touch to your Pantera. Die cut from the highest quality 3M Scotchcal in black or white. Quick and easy to apply.

- black stripes $ 50
- white stripes $ 40

WINDOW LOUVERS - by Mind-Train (see MIND-TRAIN Exclusives)

WINDOW LOUVERS - by Chastain $150

REAR ROOF SPOILER - First developed in Pininfarina's new wind tunnel for the new Ferrari Boxer, the rear roof spoiler has become the latest development in GT Racing --- appearing late in the season on the winning BMW factory team cars. $100

CUSTOM LUGGAGE RACK - A superb blend of form and function, designed exclusively for the Pantera, nestles neatly in sculptured area behind the rear window to handle traveling needs. A special feature of the rack is that it can be attached or removed in seconds through the use of special mounting hardware---which remains in place on rear deck lid. The rack is made of finest quality heavy gauge steel tubing with all welded construction. Rack and hardware are triple chrome plated. $179

CAR COVERS - are available either waterproof or water repellent for protection from the sun, dirt, wind, rain and snow. A water repellent cover will become soaked when exposed to rain or even heavy dew. A waterproof cover will not allow water to pass through the fabric. If water does get under a waterproof cover, either from seam leakage or from condensation due to rapid temperature changes, it can cause clouding of the paint because the moisture under the cover is trapped. If the fabric of the cover is water repellent, the moisture (which can also be caused from condensation by the sun) will evaporate through the pores of the fabric and no paint damage can take place.

In short, use a water repellent car cover for protection from the sun. For protection from rain or snow, use a waterproof cover.

- early (1971-1972) - water repellent $100
- late (1972L-on) - water repellent $100

- early (1971-1972) - water proof $110
- late (1972L-on) - Water proof $110

CHROME TAILPIPE TIPS - (see MIND-TRAIN Exclusives)

CIBIE "Z-BEAMS" - 7" Quartz Iodine Headlamp Conversion. The Cibie "Z-Beam" is a highly refined version of the famous European Code headlight providing a tremendous low beam range while reducing glare to oncoming traffic. By incorporating a new design of prisms into the lens and aiming them higher than ordinary headlamps, Z-beams put out a powerful beam that reaches out over 4,000 feet. An internal bulb shield with an improved bulb filament alignment limit the escape of uncontrolled light. A cut-off pattern at the top of the beam restricts dazzling glare to oncoming motorists. $ 55pr

CIBIE RECTANGULAR DRIVING LIGHTS

- clear $ 32ea
- amber $ 32ea

CIBIE RECTANGULAR FOG LIGHTS

- clear $ 32ea
- amber $ 32ea
- clear (Calif. approved) $ 32ea

CENTER LINE WHEELS - are lighter, yet stronger than the original Campagnolo cast magnesium wheels. They feature 2-piece stamped aluminum construction with exclusive aircraft rivets. No adaptors necessary.

SIZE	*LBS.*	
15 x 7	13.1	$110
15 x 8½	13.8	$120
15 x 10	14.8	$160
15 x 12	15.5	$180
15 x 14	17.7	$200

DAYTON KNOCKOFF WIRE WHEELS - These superb wire wheels are now available for the Pantera. They offer the utmost in quality, strength and elegance. Comes complete with adaptor and true knock-offs. Meticulously built by the largest and oldest manufacturer of wire wheels in the U.S.— Dayton Wheel Products.

- front 15" x 7" $265ea
- rear 15" x 8" $285ea
- lead hammer included with set of four

WHEEL SPECIALTIES WIRE WHEEL - Designed and built in California specifically for American built cars, the wheel features a strong steel hub laced to a steel rim, using forty - ¼" high strength alloy steel spokes with matching nipples. The design of the hub is such that the wheel bolts directly to your car in the same manner as the standard factory wheel. No rework or special adaptors are required. The wheels, completely and beautifully chrome plated, come with matching hubcaps.

- front 15" x 7" $125ea
- rear 15" x 8" $125ea

AMERICAN RACING WHEELS - One of the strongest one-piece aluminum wheels made, these offer the most original and distinctive design in the racing wheel market today. Built of high strength alloys and engineered to withstand the torque and wheel pressures of today's stringent freeway and race driving. Available in natural finish or highly polished aluminum spokes and bright polished flanges.

- front (natural finish)	$ 48ea
- front (polished)	$ 50ea
- rear (natural finish)	$ 54ea
- rear (polished)	$ 59ea
- lugnuts (set of 20)	$ 20

10" CAMPAGNOLO WHEELS $485ea

McGARD WHEEL LOCKS

- stock Pantera Campagnolo	$ 10
- "mag" type aftermarket wheels	$ 10

INTERIOR ACCESSORIES

PANTERA LEATHER STEERING WHEEL - Leather covered Steering Wheel for the Pantera from Italy by the manufacturer who makes all the steering wheels for Ferrari. The one-piece special alloy frame is wrapped in the finest black glove leather, hand-sewn over a resilient rubber core. Complete with hub insignia medallion. This is the same wheel that is standard equipment on the new $48,000 Ferrari Boxer. $ 75

PANTERA WOODEN STEERING WHEEL - Special new wooden steering wheel for the Pantera . . . the ultimate in classic elegance. Hand made in Italy from the finest mahogany. Complete with hub. $ 75

SCHEEL SEAT MODEL 201P - The one and only seat with adjustable backrest "as you drive". Combines superior comfort with superb support. Includes headrest and installation kit. $600pr

ARM-REST CONSOLE - The arm-rest lid is sewn of quality vinyl to match car's interior, lifts to give access to storage compartment. Ash tray and cigarette lighter fit within easy reach on plastic body (compatible with L-model consoles). $ 50

EUROPEAN STYLE CARPETS - (see MIND-TRAIN Exclusives)

SISAL MATS - (black) $25pr

MEXICO CASSETTE STEREO - True luxury. Music you like when you want it, reproduced in concert hall stereo sound. Two wavebands: AM-FM Stereo and built-in 4-track stereo cassette player. AFC, stereo balance control, volume control, sensitivity control. Tape player has fast forward, fast reverse, reject and automatic switching from radio to tape. Connection for automatic tuning by footswitch, automatic electric antenna and Reims short wave adapter. $690

GRAND PRIX STEREO - The luxury stereo radio, completely in a class by itself. Two Wavebands: AM-FM Stereo. AFC, automatic touch-bar and manual tuning. Tone control, stereo balance control, sensitivity control. Three FM and two AM push-buttons which can be set to your favorite stations. Connection for remote automatic tuning via footswitch. Power outlets for automatic electric antenna and Reims shortwave adapter. Input-jack for Stereo Tape Player 355. $550

EUROPA MU STEREO - A thrilling experience to hear such fidelity of sound in a car radio. Two Wavebands: AM-FM (Multiplex Stereo). AFC, manual tuning and by push-buttons set to your favorite stations. Stereo balance control, volume control. Power connection for automatic electric antenna and Reims short wave adapter. Input-jack for Stereo Tape Player 355. $325

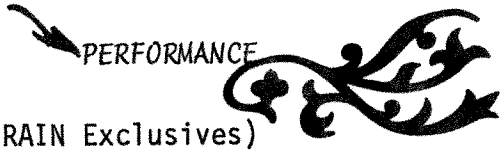
BASIC INSTALLATION KIT (for above radios) - includes Becker faceplate, knobs, 2 speakers, and hardware. $ 65

DELUXE INSTALLATION KIT (for above radios) - includes Becker faceplate, knobs, 2 Jensen Tri-axial speakers, door mounting plates, hardware, rivet gun, and instructions. $160

STEREO TAPE CASSETT PLAYER 355 (without amplifier) - Provides an extra dimension to your Europa or Grand Prix Stereo radio. Four-track cassett, connects directly to Europa MU Stereo and Grand Prix Stereo models. Very compact, easily mounted under-dash or in the glove compartment. Fast forward reverse, reject and automatic switching from radio to tape. $160

HIT 7600 SEMI-AUTOMATIC ELECTRIC ANTENNA - includes two-way switch, mounting hardware, wire. $ 35

6 x 9" SPEAKER ADAPTORS (to fit in doors) - with rivet gun and instructions. $ 35



EXHAUST SYSTEM - (see MIND-TRAIN Exclusives)

TURBO SYSTEM - (see MIND-TRAIN Exclusives)

HURRICANE FANS/MOTOR - (see MIND-TRAIN Exclusives)

OFFENHAUSER AIR CLEANER - This 14" diameter air cleaner provides more clearance between the air cleaner and engine grill. It features open sides around the perimeter for better air flow to the carburetor. $ 25

HOLLEY CARBURETORS - offer the ultimate in high performance carburetion. They will fit the Edelbrock Manifolds or the early '71 Ford/ Pantera manifold. Five models are offered to cover a wide variety of needs.

- 600 cfm (street use)	$ 80
- 600 cfm w/ EGR system (street use)	$ 80
- 650 cfm double pumper (street use)	$100
- 735 cfm (hi-performance)	$ 85
- 850 cfm double pumper (competition)	$125

EDELBROCK HI-RISE MANIFOLD F351 - The Hi-Rise manifold incorporates the famous Edelbrock 180° balanced firing order, with exclusively smooth low ports; thus allowing unrestricted flow continuously...each cylinder receiving an equal flow without interruption. The 180° design gives you complete distribution throughout any operating range. Used by racing professionals, the name Edelbrock has always stood for quality high-performance products. Where necessary, provision for smog device has been made for this manifold. Includes Ford Motor Co. intake gasket and set of required bolts. $130

EDELBROCK TORKER 351 - A high performance manifold with better mid-to-high RPM performance than the Hi-Rise F351 and with a slight loss of low RPM response. It has provision for EGR (exhaust gas recirculation) systems. This manifold is 5/8" higher than the F351 and will not fit under the hood of the Pantera with its stock air cleaner. Includes Ford Motor Co. intake gasket and set of required bolts. $155

ALUMINUM VALVE COVERS - These sharp looking aluminum valve covers are a snap to install. Just remove the stamped steel ones and replace.

- Natural Finish Boss 351	$ 40pr
- Polished	$ 50pr
- Black Krinkle Finish	$ 30pr

KONI SHOCK ABSORBERS - Every Koni Shock Absorber is factory tuned for a specific car and model; and is designed with a unique valve adjustment which permits further adjustments to your individual driving needs. Koni Shocks are a necessity for competition driving and the driver who demands superior handling of his car. Koni Shocks bolt on to the original mounts of your car without modifications and come complete with installation instructions. Famed for lasting 100,000 miles, and available for virtually all post-war cars; one Koni ride and you will ride Koni forever. Includes set of DeTomaso bushings.

- front	$ 69ea
- rear	$ 69ea

PERFORMANCE CAMSHAFT KITS - Camshafts and coordinated valve-train kits can improve your gas mileage or increase your power. 30% discount on all Crane, Crover, Iskendarian and Sig Erson cams and assemblies. Write for specific cam recommendation giving complete information on modifications planned, or already on the car, and intended use of the car. This is one of the best ways to tune the Pantera to your way of driving. 30% off

JACOBS IGNITION COMPUTER - This ignition system is compatible with both conventional point distributors (stock) and the newer electronic distributors. It is the only system that exactly tunes the spark to guarantee maximum combustion efficiency. This patented ignition computer is the only one that carries a money back guarantee. $100

HURST/AIRHEART DISC BRAKES - These brakes were developed on the Mind-Train Pantera by Hurst/Airheart, the leading manufacturer of racing disc brakes. This system includes four larger vented rotors, four aluminum 4-piston calipers, missle brake lines, four machined aluminum hats, and necessary hardware for installation. Truly the ultimate in braking control, they must be felt to be believed. $1785

AEROQUIP BRAKE LINES - Replace your flex brake lines (found between inner fender wells and wheel cylinders) with steel-braided aeroquip lines. These lines will not balloon nor expand and are one solution to the spongy brake feel. Our lines utilize steel end fittings rather than the easily-stripped aluminum fittings sometimes used. Proper fittings assure simple attachment. For use with stock brakes. $ 55

LEGS - (also see MIND-TRAIN exclusives) - Adjustable upper A-Arms allow proper adjustment of Camber (not possible on many Panteras) and also allows widening of rear track (up to 2 inches total) to super-tune handling characteristics. Helps fill void between rear wheel and body.

- Chrome Moly $280
- Stainless Steel $380

WHEEL BEARINGS - U.S. made top quality bearings keep wheels rolling. The rear bearings feature a teflon or compound seal and are pre-lubricated. Lower quality bearings are around but these are the best available.

- front (one wheel) $ 17
- rear (one wheel) $ 36

TEFLON A-ARM AND SHOCK BUSHINGS - Machined from high grade teflon. These bushings are designed to replace the stock metal and rubber one. These bushings will give your suspension a more positive and precise feel.

- shock bushings (set of 8) $ 60
- A-Arm bushings (set of 8) $ 60
- A-Arm bushings (set of 16) $120

SHORTENED U-BRACKETS WITH TEFLON BUSHINGS - These brackets are designed to replace the stock brackets and bushings at the lower rear A-Arms. By slightly narrowing the rear track, these brackets allow for 3/16" positive camber adjustment in those Panteras where removal of all shims will not provide proper camber.

- set of 4 $ 80
- set of 4 with 4 teflon bushings $110

NEW U-JOINTS - from Ford $59.25ea

NEW REAR AXLES - from Ford $ 75ea

REBUILT AXLES - Welded and machined axles. Lathe turned to tolerances equal to or better than stock.

$40ea, plus $10 core charge. ($10 refunded when old axle is returned.)

10-QUART STEEL OIL PAN - This modified oil pan will increase the oil capacity for those engines that require it.

$200, plus $30 core charge. ($30 refunded when oil pan is returned.)

MISCELLANEOUS

FLAME-OUT ON-BOARD FIRE CONTROL SYSTEM - Manufactured to the highest aircraft standards, this compact mini-system discharges approximately 35 seconds of Dupont Freon FE-1301 over the desired locations. Complete remote control offers quick and safe fire protection, especially in a car such as the Pantera where engine compartment access is not easily attainable. FE-1301 leaves no residue, no foam and no dry powder; reducing costly after-fire cleanup. With other fire extinguishing agents, cost of repairing engine damage can exceed the cost of damage by fire. Complete with valve, gauge, clamps, nozzles, and installation instructions. $150

THERMAL TIME-DELAY AUTO ALARM - Hidden interior switch activates and deactivates this alarm (no visible alarm lock on exterior). Time-delay feature (10-20 seconds) allows normal entry and exit for the owner. $ 32

MIND-TRAIN PANTERA CATALOG - The most informative catalog of Pantera accessories available. The catalog is unique because our whole approach to selling is to make the buyer aware so that an intelligent choice can be made. If you're going to invest some money in accessories, modification, or upkeep of your Pantera, then a $35 investment to get a GOOD look and expert advice is more than worth it.

It includes special articles and updates, large 8" x 10" quality photos, samples, and much more. WHAT EVERY PANTERA OWNER SHOULD HAVE! $ 35

Prices effective January 1, 1978. Shipping via UPS.

California residents, please include 6% sales tax.

MIND-TRAIN Enterprises cannot guarantee that a Pantera equipped with parts in this catalog will comply with State or Federal lighting or emission regulations. Please consult local codes for legality.

MIND-TRAIN Enterprises

PANTERA ACCESSORIES

Our prices include shipping via U.P.S. Blue Label (air) except as noted. When ordering by mail, please be sure to include phone number.

NEW, UNCOMPARABLE, BEST-ON-THE-MARKET, IN STOCK, CONSTANTLY EXPANDING, EXCLUSIVE MIND-TRAIN ENTERPRISES PANTERA STUFF

Description	MT Price
Thunderbird Stage II Headers	$ 150.00
Big Throats Tailpipe & Muffler Assembly (Straights - 1971-72 Panteras)	185.00
Big Throats Tailpipe & Muffler Assembly (Angles - all Panteras)	185.00
Resonator Inserts (for tailpipes)	50.00
Crossover & Equalizer Assembly (kit)	50.00
(Complete Exhaust System - discount)	(400.00)
Chrome Exhaust Tips	
Show Quality - Weld-on attachment	50.00
Concours - Set Screw attachment	40.00
Concours - Weld-on attachment	30.00
Window Louvers (via truck)	385.00
Hurst/Airheart Disc Brakes	1785.00

(ADDITIONAL ACCESSORIES)

Description	MT Price
Fender Flares (Hand Laminated)	$ 150.00
Front Spoiler (via truck)	
early model (1971-1972)	200.00
late model (1972L-on)	200.00
Rear Roof Spoiler	85.00
Custom Racing Stripes - (black)	40.00
- (white)	40.00
Custom Luggage Rack	145.00

1966½ S. Robertson Blvd. Los Angeles, CA 90034 (213) 836-4106

Description	MT Price
Front Bumper Guard (1971-1972 only)	$ 40.00
Front Air Dam - early model (1971-1972)	100.00
- late model (1972L-on)	100.00
Car Covers -(Water Repellent covers have soft Tan Flannel underside, while Water Proof covers include waterproof hyperlon coating.)	
- early (1971-1972) - Water Repellent	100.00
- early (1971-1972) - Water Proof	110.00
- late (1972L-on) - Water Repellent	100.00
- late (1972L-on) - Water Proof	110.00
Pantera Bra -early (1971-1972)	70.00
- late (1972L-on)	70.00
Chrome Tailpipe Tips (See New Mind-Train Stuff)	
Dayton Knockoff Wire Wheels - (front - 15" x 7")	265.00ea
- (rear - 15" x 8")	285.00ea
-lead hammer included with set of four	
Wheel Specialties Wire Wheel - (front - 15" x 7")	125.00ea
- (rear - 15" x 8")	125.00ea
American Racing Wheels - (front) - natural finish	48.00ea
- (front) - polished	50.00ea
- (rear) - natural finish	54.00ea
- (rear) - polished	59.00ea
- lugnuts - (set of 20)	20.00
Pantera Leather Steering Wheel	69.00
Pantera Wooden Steering Wheel	75.00
Scheel - Seat Model 101 - (Discontinued due to constant unavailability from U.S. Importer. For more information, please call us collect.	199.00
Arm-Rest Console - 1971-1972, early 1972L - (old dash)	50.00
- late 1972L-on - (new dash)	50.00
Mexico Cassette Stereo	690.00
Grand Prix Stereo	550.00
Europa MU Stereo	325.00
Installation Kit (for above radios) - includes faceplate, 2 speakers, and hardware - (not shown)	65.00
Hit 7600 Semi-Auto Electric Antenna (for above radios) - (not shown)	35.00
Stereo Tape Cassette Player 355 (w/o amplifier) - (replaces model 208)	160.00

1966½ S. Robertson Blvd. Los Angeles, CA 90034 (213) 836-4106

Description	MT Price
Aluminum Valve Covers - natural finish Boss 351	$ 40.00pr
- polished Cal Custom	50.00pr
- black krinkle finish	30.00pr
Offenhauser Air Cleaner	25.00
Holley Carburetors - 600 cfm (street use)	80.00
- 600 cfm w/ EGR system (street use)	80.00
- 650 cfm double pumper (street use)	100.00
- 735 cfm (hi-performance)	85.00
- 850 cfm double pumper (competition)	125.00
Edelbrock Hi-Rise F351 Manifold (with Ford Motor Co. intake gasket and set of required bolts)	130.00
Edelbrock Torker 351 Manifold (with Ford Motor Co. intake gasket and set of required bolts)	155.00
Koni Shock Absorber (with set of DeTomaso bushings)	
- (front)	69.00ea
- (rear)	69.00ea
Performance Camshaft Kits	30% off list
Flame-Out On-Board Fire Control System	150.00
Thunderbird Stage II Headers (See New Mind-Train Stuff)	

ITEMS NOT SHOWN

Sisal Mats (replaces coco mats) - (black)	$ 25.00pr
Thermo Time-Delay Auto Alarm	32.00
Cibie Rectangular Driving Lights - (clear)	32.00ea
- (amber)	32.00ea
Cibie Rectangular Fog Lights - (clear)	32.00ea
- (amber)	32.00ea
- (clear) - Calif. approved	32.00ea
Cibie "Z-Beams" - 7" Quartz Iodine Headlamp Conversion	55.00pr
McGard Wheel Locks - (stock Pantera Campagnolo)	10.00
- ("mag" type aftermarket wheels)	10.00
"Jacobs" Ignition Computer	100.00

California residents, please include 6% sales tax.

MIND-TRAIN Enterprises cannot guarantee that a Pantera equipped with parts in this catalog will comply with State or Federal lighting or emission regulations. Please consult local codes for legality.

1966½ S. Robertson Blvd. Los Angeles, CA 90034 (213) 836-4106

Hi!

Now that you've read our articles and perused our photos, I'd like to tell you a little about the trio who runs MIND-TRAIN — John, Fred, and yours truly, June.

First of all, our name — MIND-TRAIN. To me, it means brainstorming, improving on the old and coming up with things that are new and unique. It means that the world is not stagnant, that it's always moving forward with force and power, and at the same time, pulling out all of the good things from the past and taking it along with you. And, believe it or not, coming up with our name, MIND-TRAIN, was one of the most difficult things we've ever done.

Now to introduce John and Fred. . .they're both very down-to-earth people and they're the brains of the whole operation. John studied physics at school and at the same time was an automobile buff - working as a mechanic to put him thru college, building up (and repairing) his own cars, racing, etc. Fred was an architect, designing casinos and restaurants. He too is an auto-buff, but he doesn't like to work. His experience with engines, automobiles, and hot rods goes back to when he built his own '30 Ford hotrod and his go-carting days. (If that makes him sound old, he's not! It just means that he's got a lot of experience and know-how in him.)

As far as I'm concerned, I'm like Fred. . .I don't like working either. I'm just interested in how things work and want to learn how to work on my own car so that I won't have to depend on anyone. . .not a women's-liber but a "do-it-yourselfer", you might say.

We are the same trio who made Pantera International happen. We started the club because when we bought our first Pantera, we found that when things went wrong, not many people knew what they were doing to our car; items for the Pantera were either unavailable or overpriced; and most important of all, if you wanted to get things done right, you had to do it yourself. We felt that a good communication among Pantera owners was invaluable, hence the birth of the club. However, we don't

handle that any more because John and I (both single, mind you) got restless and started traveling for a year and a half. That left poor Fred here to do the work, but his easy way out was to hand the whole thing over to your present coordinator.

Another thing the three of us have in common is that we all want to retire soon but we want to feel good about how we do it. That's why the products we come out with and the service we offer are quality stuff. We ship via UPS-Blue Label (Air) so that you can get quick delivery. We also pay for shipping to minimize extra paper work for both you and I. (I handle the bookkeeping department.)

All I've got left to say is, if you have any questions about your car—ask me, and if I can't help you (which is most of the time), John or Fred can. They're both very friendly and as far as I'm concerned, they know it all.

Yours truly,

June Tuey

June Tuey

P/S: And I wouldn't let anyone work on my Datsun Roadster or '56 Mercedes except John, Fred, or Robert. Robert's our mechanic. . . only a proletariat, but we are extremely good to him. He's also our resident Holley carburetor expert! ENJOY.

"CAPACITIVE DISCHARGE AND OTHER TYPES OF ELECTRONIC IGNITIONS EVALUATED"

by Dr. Christopher A. Jacobs

Before an evaluation of the various types of solid state (electronic) ignitions can be undertaken, it is necessary to understand some of the basic principles and problems associated with the ignition process. The process by which an electric spark can cause a mixture of gasoline and air to ignite is probably the most misunderstood phenomenon associated with the automobile. There are two reasons why there is confusion regarding the ignition process. The first comes from the fact that electricity cannot be seen. Most electrical processes have to be visualized or imagined. The second cause of confusion in the area of ignition, stems from a misinterpretation of the following fact: "Once the flame is started in the combustion chamber, the ignition system can do no more." That is, once a flame front has begun, all ignition systems have worked equally well.

While this statement is correct, it assumes that all ignition systems are equally likely to start the air/fuel mixture burning. This is decidedly not so. As a matter of fact, the entire ignition process is <u>always</u> probabilistic. That is to say, there is <u>always</u> a non-zero chance that at any one time ignition will not occur. The unburned air/fuel mixture will then be dumped into the exhaust pipe, where it will probably ignite from the heat of the exhaust manifold. When this happens no power is extracted from the gasoline and a pure waste has occurred. The only thing that the ignition system designer can do is to attempt to lower the probability of a misfire. He can never completely eliminate this chance.

There are three relatively easy things which could be done in order to reduce the probability of misfire:

A. Increase the amount of spark energy.
B. Use a larger spark plug gap.
C. Use an air/fuel ratio which minimizes the chance for misfire.

All these three items are related. The air/fuel ratio of 11 parts of air, by weight, to one part of gasoline requires the least amount of spark energy to cause ignition. Since ignition is more difficult in a colder engine than it is in a warmer one, a choke is used to provide this richer mixture. The purpose of this richer mixture is primarily to allow the weaker conventional ignition to ignite the gasoline even when the engine is cold. Once the engine warms up and the choke backs off, a ratio of 13.5 to 1 is usually maintained.

Dr. Jacobs holds 4 patents (2 others pending) in the area of electronic ignition and is the inventor of the "PULSAR" ignition computer.

ignite the air/fuel mixture a good portion of the time. However, it must be decided what percentage of misfires is acceptable. Certainly one misfire in 10,000 is not substantially hurting the performance or economy of the automobile.

The ignition system designer has been traditionally caught between the desire to have a leaner air/fuel mixture for economy, to reduce the amount of misfires, and at the same time not have an excessive spark plug erosion rate. Contrary to what advertisements may lead one to believe, neither transistorized nor capacitive discharge systems can overcome this inherent problem. It was for this reason that the "computerized-ignition system" was developed. This system, with its on board computer, determines the spark energy required for each ignition cycle, cylinder by cylinder, time by time. By so modifying the ignition spark a computerized-ignition system can deliver ultra-high energy only when needed. This type of system finally achieves the goal of a drastic reduction in the percent of misfires while maintaining the spark plug erosion rate at a very low level (.0005" per 1000 miles driven). With a computerized-ignition system spark plug erosion rate can be kept so small that 40,000 miles between tune-ups is practical. [Editor's note: The PULSAR and the JCI(Jacobs Computerized Ignition) are the only two present examples of computerized-ignition systems]. The computer in these ignition systems determines if the gasoline and air have been ignited, and if not, how the spark should be modified in order to cause ignition. The computations and spark modifications occur so rapidly that as many as 5 to 10 modifications of the spark can occur each time a cylinder is to be fired. The net result is that the system will virtually assure firing of the air/fuel mixture, but with the minimum amount of energy.

From the above discussion it might be concluded that it is desirable to have the smallest possible spark plug gap, since the objective is to keep the gap from growing too large. Unfortunately ther are conflicting objectives. From a purely ignition standpoint, the larger the gap, the more likely the ignition of the air/fuel mixture. This comes from the fact that the larger the gap, the more chance there is for an electron leaving the center electrode to collide with a gasoline molecule as it arcs toward the side electrode. Since ignition is probabilistic in nature, there is always a non-zero chance that all the electrons leaving the center electrode will be able to cross the gap without colliding with enough gasoline molecules to initiate combustion. However, the larger the gap, the longer the arcing path, and the less likely it will be that the electrons can make it all the way across the gap without colliding with gasoline molecules. Practical considerations discussed above limit the size of the spark plug gap.

The smaller gaps recommended by the automotive manufacturers (.028" - .035") are not set for insulation protection however, but due to the fact that a conventional ignition system cannot produce sufficient output voltage to reliably arc over gaps

misfires are reduced this unobserved vibration is also reduced, and so is engine wear.

Turning from the theoretical to some of the more practical considerations in purchasing and installing ignition systems, the first question which arises is whether or not there is an advantage to breakerless ignition systems. If one were going to use a capacitive discharge or a computer-controlled ignition, the advantage is negligible. With capacitive discharge and computer-controlled ignitions the points virtually do not wear out. The concept of the breakerless ignition preventing the need for point maintenance is theoretically correct. However, long term practical experience has shown that with a capacitive discharge or a computer-controlled ignition the points will easily last 40,000 miles with little or no deterioration. Therefore the problem of point wear with a capacitive discharge or a computer-controlled system does not exist. The breakerless ignition system might be classified as "a solution looking for a problem." On the other hand if one were to simply replace the conventional distributor with a breakerless system and use the coil in the conventional way, that is not in the capacitive discharge or computer-controlled manner, then the breakerless system would prevent the need for changing points. The performance of the breakerless, conventional type, ignition system is no better than the point type conventional ignition system, and in no way can measure up to the performance of a computer-controlled or even a capacitive discharge system. That is, plug fouling and all the other problems associated with this are just as common in a breakerless-conventional mode ignition system as they are in a point-conventional ignition system.

When installing an electronic ignition system certain points will be very hepful. If the system is a capacitive discharge or a computer-controlled system do <u>not</u> replace the old ignition points. These older points have already seated in and will give better performance than a new set! In addition tne oil vapors coming up the distributor shaft will tend to plate out on all things inside the distributor cavity, such as the points, the rotor and the distributor cap. Since electronic ignitions in general do not have arcing across the points, the oil vapor which deposits on the points could lead to their becoming insulators instead of conductors. The pitting associated with an old set of points is very helpful, penetrating the thin oil film and thus making contact with the mating point.

Rubbing block wear can be drastically reduced if a good quality distributor cam lubricant is spread on the distributor cam when the ignition system is being installed. Delco-Remy high speed distributor cam lubricant is probably the best long term, long wearing distributor cam lubricant for this purpose. It is available at many auto parts stores as well as speed shops.

The oil vapor coming up the distributor shaft will

the plug occurs. This is even more true when a cold engine is started. Flooding is an extreme example of fouling, in that tne wet gasoline drains tremendous energy from the spark plug tips. Unlike carbon fouling, however, the fouling due to gasoline will disappear as the gasoline evaporates. When a misfire occurs with carbon fouling, both the spark plug and the wall of the combustion chamber are wetted with gasoline. Therefore, when the next air/fuel mixture is brought into the cylinder, the gasoline left deposited in the combustion chamber leads to a very rich mixture. This mixture is somewhat easier to ignite since it is closer to the ideal 11 to 1 air/fuel ratio. When this mixture ignites, all the gasoline cannot be burned completely due to the lack of air. The partially burned gasoline further plates out onto the plugs. This increases the energy drained off the electrode tips and leads to even more excessive fouling. This "snowballing effect" of spark plug fouling explains why a car will run well for a period of time then all of a sudden start to misfire quite badly and show such a rapid deterioration in performance.

New carbon is always being deposited on the spark plug tips. This would inevitably lead to fouling in all ignition systems except for the fact that the carbon also leaves the tip and goes into the combustion chamber. That is to say, if one could put a tag on a carbon molecule and drive the car for a couple of weeks then remove and inspect the plug, he would find that the original carbon molecule is probably no longer on the tip, but one or more new carbon molecules have replaced the old one. This is called "carbon migration effect." The object of an ignition system cannot be to prevent carbon from depositing on the tip, for it will do this in any event. The object can only be to have an ignition system so immune from misfires due to fouling that the migration effect will allow the carbon to migrate to the combustion chamber fast enough to prevent misfires due to fouling. Here again, the capacitive discharge ignition system to a certain extent and the computer-controlled ignition to a much greater extent are very helpful in allowing the migration effect to cause carbon to be removed before the snowballing effect can drastically increase the rate of carbon deposits. The computer-controlled ignition has the extremely important advantage of being able to dramatically increase the spark plug energy when it senses that fouling is occurring. Therefore the computer-controlled ignition can in most instances prevent a slightly fouled plug from leading to a snowballing effect.

The high speed, high power engine is more susceptible to carbon fouling than a low speed engine. The reason for this is "combustion chamber turbulence." As its name implies, combustion chamber turbulence is a measure of how turbulent the mixture of air and fuel is in the combustion chamber prior to ignition. For any given engine and load the turbulence increases in direct proportion to the increase in engine rpm. However, engines can be designed to have high turbulence even at low engine rpm by shaping the combustion chamber in the proper manner.

Article reprinted with permission from Spring 1977
issue (Vol. 3, No. 4) of Pantera International News.
Pantera International. 18704 Chase St., Northridge, CA 91324

BRAKE! TALK

By John L. Chung (#2)

Nobody is sure of when the wheel was "invented", but one thing is for certain - as soon as it was invented, man was trying to find ways to stop it.

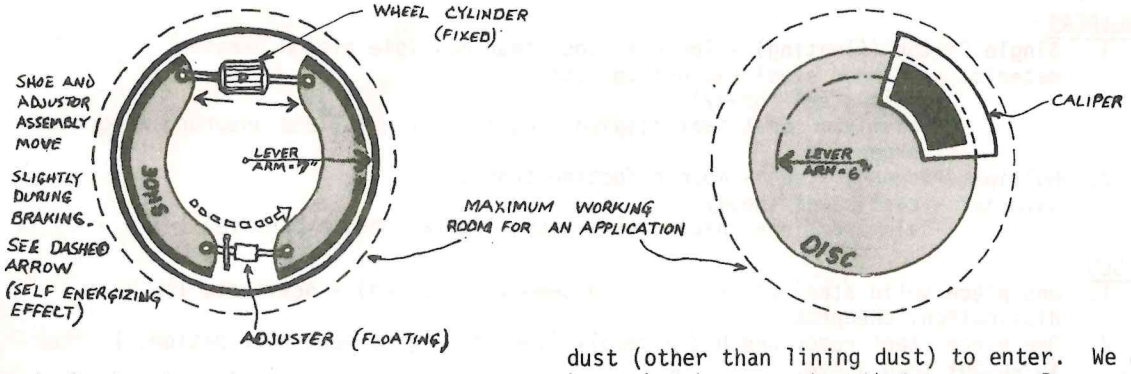
In this article, I will attempt to explain a few of the many variables involved with the operation and design of braking systems and how they apply to cars in general and to the Pantera. A solution to inadequate braking is offered for those who may be interested.

I would like to ask those of you who have the Fall 1976 issue of PI News to please re-read Jim Bell's article on brakes. The following are a few of the comments or additions I would like to make regarding his article. (The comments follow his sections by number.) (#2) An aftermarket camshaft with duration of more than say 290° will also adversely affect a stock Pantera's braking performance. This is due to the lower operating vacuums inherent with such cams. Low vacuum levels will make the vacuum booster almost worthless. With the brake fluid pressures needed in the stock system, this reduction of vacuum assist will cause embarassment and worse. (#4) Right on Jim! And that's when everything's working well! (#12) The proportioning valve allows the rear brakes to work at higher fluid pressures than the front ones - the fact that the rear wheels don't lock up on sudden panic stops (when the front ones do) may mean that the valve is not working. (#13) It takes a new system. (#14) Read on.

DRUM BRAKES vs. DISC BRAKES

From the standpoint of theory alone, drum brakes are superior to disc brakes. First of all, the lever arm at which the brakes apply is greater with a drum brake than with a disc.

Second, drum brakes are self-energizing. That is, as the pressure applied to the brakes increases, the design permits the brakes to feed more working force into the system. However, this mechanical advantage depends also on the amount of friction between the shoes and the inside surface of the drums. If the left brake at any one instant starts to work more than the right, this self-energizing factor will cause the left brake to work "a whole lot more" than the right. Result - uneven braking which leads to a definite pull (to the left in this case).



As for cooling (dissipation of heat), disc brakes are far superior. With drum brakes, most of the working surface of the drum is actually in contact with the shoes. This prevents air from reaching the contact area. In addition, all of the working area and linings are in an enclosed "drum", further complicating the problem. Drums or backing plates are not ventilated for cooling as that would allow road splash (water, dirt, dust (other than lining dust) to enter. We all know what happens when that occurs. Drums sometimes have cooling fins on the outside but that doesn't really solve the problem.

With discs, however, only a small portion of the actual working surface is in contact with the linings. Also, the working area is not enclosed. This enables cool air to do its job.

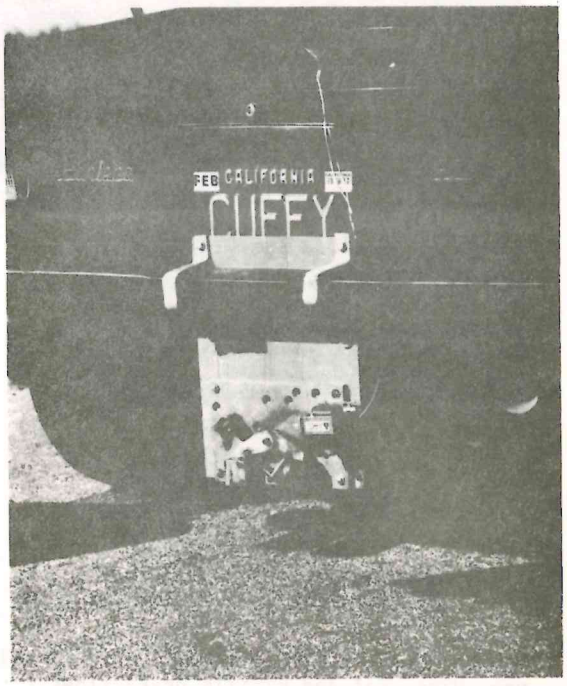
A couple of questions may arise in the readers' mind once reading the above table. First of all, does aluminum have the proper qualities for use in a brake system? The answer is yes. Aluminum is the ideal heat radiator, strong and light weight.

In 1975, the NASCAR racers started using the H/A disc brake which utilizes both an aluminum hat (with vented disc, of course) and aluminum calipers. These 4000 pound cars which must repeatedly decelerate from speeds in the 180-200mph range are a true test of disc brake capabilities and worthyness. In 1976, a car not equipped with above brakes was not competitive anymore (ask anyone who is a NASCAR fan). Imagine being able to go 10 car lengths deeper into each turn before braking and what that will do to lap times! These drivers want to win, of course, but they also want to protect their investments and their lives.

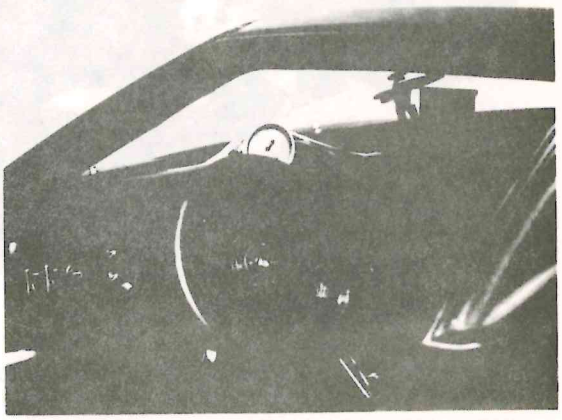
Second, if aluminum works so well, why isn't the rotor machined out of aluminum? It's been tried, believe me. Unfortunately, as the temperature of the rotor rises to operating temperatures, the strength of aluminum drops way down. Exploding rotors when you're entering a curve must be terrifying, indeed. Speaking of rotors, some people have also tried cross drilled rotors. These also have a tendency to explode upon hard usage and are not really necessary if the correct brake is chosen for the application. There also exists another type of rotor which is by far the most expensive. They are sodium filled for ultimate heat dissipation. Ever heard of sodium filled valves?

A lot of emphasis has been placed on a brakes' ability to dissipate heat. This is the primary job of any brake, next to slowing or stopping a car, of course. What a brake actually does during operation is convert the kinetic energy (energy a moving body has) into heat. This heat must be dissipated, as mentioned earlier, for proper brake operation. If a rotor cannot dissipate the heat quickly enough, the linings will overheat. Using linings with a higher thermal conductivity and designed for racing use will help prevent brake fade but will also cause two other things: 1) Increased pressures are required and 2) linings must be warmed up for proper braking to be achieved.

Vented rotors are a must. Vented rotors provide roughly twice the surface area and even more in terms of heat dissipation (due to the fan effect possible with vented discs).



To obtain accurate stopping distances, this gadget was used to locate braking point. Paint filled .22 caliper shell fires when triggered by stoplight-activated solenoid.



Taped to dash is a brake-line pressure meter. For approximate on-the-spot reading of deceleration, the visible decelerometer was used.

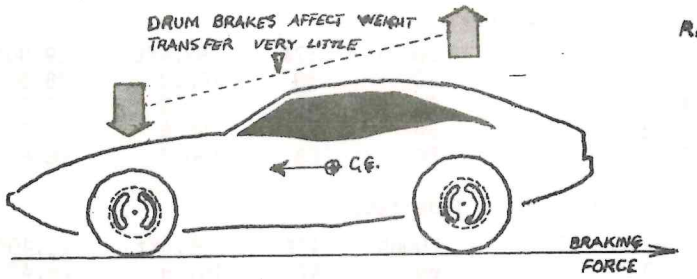
The car was tested with the new brakes and two things were discovered. First of all, the inherent "dive" experienced during hard braking with stock brakes was gone! Caliper placement on the front wheel of a motorcycle has a definite effect in this area. It was discovered that the placement of the H/A caliper on the rear changed the overall weight transfer during braking. The car "squats" instead of diving. (Please refer to designs below.)

H/A BRAKE DATA

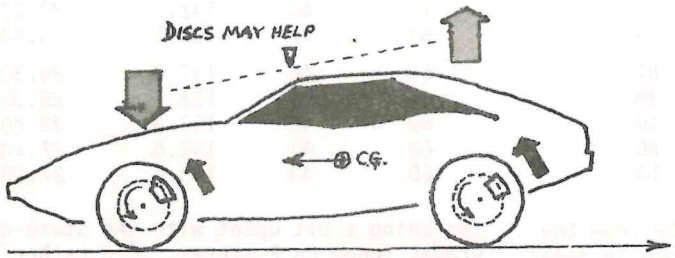
	(FRONT)	(REAR)
CALIPER -	156 x 2 (4 PISTON 2 PAD)	138 x 2 (4 PISTON 2 PAD)
PISTON DIA. -	1 9/16" x 4	1 3/8" x 4
PAD AREA -	8.3 x 2	8.3 x 2
TORQUE -	14,195 ft-lbs.	11,000 ft-lbs.
ROTOR DIA -	12.2" (11.0 STOCK)	12.2" (11.9 STOCK)

WEIGHTS	(STOCK)	(H/A)
FRONT SET (ONE SIDE)	31#	21#
REAR (ONE SIDE)	15#	19
	-46 REMOVED	40 REPLACED

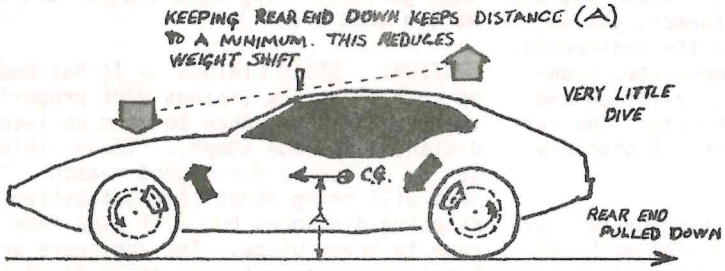
- TOTAL UNSPRUNG WEIGHT REDUCTION = 12#



DRUM BRAKES - DIVE DURING HARD BRAKING DUE TO WEIGHT TRANSFER



CONVENTIONAL DISCS - PLACEMENT OF FRONT CALIPER HELPS, REAR ONE HURTS



MIND-TRAIN'S 4-WHEEL ANTI-DIVE SQUAT SYSTEM - SIMPLE CALIPER MOUNTING CHANGE MINIMIZES DIVE INHERENT IN OTHER SYSTEMS

Also discovered during the initial series of tests was the fact that the balancing of the brakes was slightly off. The rear brakes were developing more braking force than the front brakes. This didn't allow the front brakes to work at optimum. One easy solution would have been to use different linings (lower coefficient of friction) in the rear.

But this would have meant balancing of the brakes at a cost of lower overall efficiency. Another similar solution would have been to re-introduce a proportioning valve in the system to lower the pressure to the rear. Instead, the engineers at Hurst/Airheart replaced the front calipers with larger ones (156x2). This solved the problem and a second series of tests with the H/A brakes was conducted.

RESULTS

Following are the results obtained when H/A compared the stock brakes with their solution. To be a fair test of the brakes and not the tires, all stops were made under a controlled situation (maximum possible braking without having the car go into a skid -wheel lockup). Once skidding (wheel lockup) occurs, the brakes no longer control the rate of deceleration. It is instead a combination of tire size, tire compound, and footprint size that determines how fast the car will stop. The driver exerted as much pressure as was required to stop the car in a minimum distance and under a controlled situation as explained above.

MIND-TRAIN Enterprises

1966½ S. ROBERTSON BLVD.

LOS ANGELES, CAL. 90034
(213) 836-4106

Pulsar C.D.I.

HURRICANE MOTORS

WITH 6-BLADE FANS

(2) 6-BLADE FANS - 50% wider, 10% longer blades with greater pitch angle. Comes with critically machined hubs of light-weight aluminum, aluminum bolts, and castleated aluminum nuts. Safety-wired (very 'trick').

(2) HEAVY-DUTY MOTORS (NEW, NOT "TRICK-REBUILT") - Rated at twice the horsepower of stock motors with soldered prongs that plug into stock wires. No splicing or soldering necessary. Silicone sealed to prevent water entry. (Stock motors often fail because they aren't sealed.)

(2) CUSTOM-MADE ALUMINUM SHROUDS WITH NEOPRENE TRIM - Fan-motor-shroud assembly comes fully assembled. Bolts directly to stock motor mounts.)

OR

(2) ALUMINUM SHROUD EXTENSIONS WITH NEOPRENE TRIM - (Attaches to stock shroud.)

COST:

$235 - fans, motors, and custom-made aluminum shrouds.

$175 - fans, motors, and aluminum shroud extensions.

If the fan kit doesn't solve the problem, we'll refund your money.

Overheating?

Overheating is perhaps the most common malady affecting the Pantera. Although it may not be as potentially dangerous as wheel bearing failure (lock-up) or brake failure, it is none-the-less annoying as hell. It has been said that a car is the extension of a man's masculinity (or a female's independance), but is a "reliable" car too much to ask for? Too many of us have to cope with "gauge-watching" when the city approaches or when traffic slows down. Nothing is more frustrating than having to stop and let the engine cool. If your Pantera overheats, the following information will be welcome news.

As far as Panteras are concerned, overheating problems can be divided into two major catagories with the first more common than the second by far.

A. Overheating at extended idle periods or in stop-and-go traffic. (Runs cool at higher speed.)
   CAUSE: Insufficient air flow <u>through</u> radiator at idle or slow-speed driving.

B. Continual overheating (regardless of vehicle speed).
   PROBABLE CAUSES:
   1. Blown head gasket.
   2. Dislodged radiator baffle.
   3. Air in cooling system. (Improperly bled or possible leak.)
   4. Incorrect timing.
   5. Carb setting too lean.
   6. Inoperative water pump. (Fan belt slipping or broken.)

As perviously mentioned, case 'A' is much more common and it is for those of you who experience this sort of "overheating" that this article was prepared. When the Pantera is moving normally, there is enough air forced through the radiator by the motion of the car so that the fans are not necessary. In fact, wear and tear on the fans can be minimized by incorporating a remote control switch to turn off the fans on long trips

Overheating in stop-and-go traffic is so common (almost inherent) with Panteras for two reasons. First of all, the cooling fans are electrically driven rather than belt driven as with conventional front-engine autos. Second, the fan-motor combination chosen by the factory is inadequate. To see how true this is, place your hand behind the radiator when the fans are operating and feel the amount of flow through the radiator. Then try the same with any other conventional auto and see how much more air is being sucked through the radiator. (Make sure the declutching mechanism is engaged, if so equipped, and watch out for the blades!)

Our solution is simple, better designed blades and more powerful motors to provide the needed flow at slow speeds or at idle.

The MIND-TRAIN "Hurricane" Motors are designed to run at 11 amps and have the power to pull two 6-blades that are each 50% wider than the stock Pantera's 4-bladed fan.

First testing of the "Hurricane" Motors and 6-blade fan assembly was on a Turbo-Pantera. (Turbocharged Panteras have a tendancy to run hotter.) Stock 192^{o} thermostat and thermal relays were retained for this test.

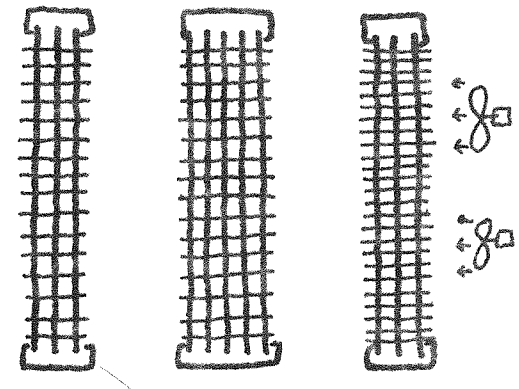
The engine was allowed to run at idle to see how high the water temperature would rise. The temperature rose to 200^{o} F and then stabilized at 198^{o} - 200^{o} F with only one "Hurricane" fan running. The second fan did not turn on as it was not necessary. Next, we disconnected both fans and allowed the water temperature to rise to 225^{o} F. At 225^{o} F, we reconnected one "Hurricane" fan only to see what would happen. Though the one fan could not return the water temperature to a normal temperature of 198^{o} F, neither did it rise to an overheating condition as seen many times with both stock Pantera cooling fans working. Next, the other fan was connected and the water temperature dropped to 198^{o} F within 10 minutes. At this temperature, the second fan automatically shut off and the one fan handled the cooling needs of the engine.

We are so confident that the "Hurricane" fans will end cooling problems in stop-and-go traffic that we offer a money-back guarantee if they do not satisfactorily cool your Pantera.

Some of you may have already tried other 'solutions' with disappointing results. Here's why:

SOLUTION 1:

HEAVY DUTY RADIATOR



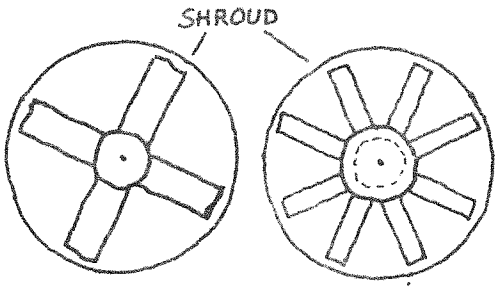
PROBLEM:

Heavier duty radiators are either thicker or have closer core spacing to take advantage of a larger surface area. The trouble is that this added thickness or density is an advantage only if you can move air through the radiator. Since stock fans are inadequate, this is a poor solution indeed (for the Pantera with electric motors, that is). Heavy duty radiators will cool better at speed but will not solve the overheating at idle. If you already have a modified radiator, then our fan kit is needed even more to realize full benefits.

SOLUTION 2:

8-BLADE FAN CONVERSION WITH ADAPTOR HUBS

Adaptor hubs are necessary since most fans are designed to bolt to a belt-driven water pump instead of an electric motor.



MAXIMUM OVERALL DIAMETER IS LIMITED BY STOCK SHROUDS. DOTTED LINE SHOWS LOCATION OF STOCK MOTOR.

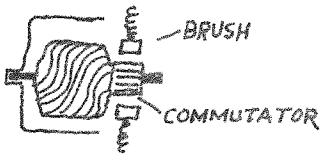
PROBLEM:

The idea here is - the more blades, the better. This may be true if each blade is wider than stock and if the pitch (twisted angle) is the same or greater. Assuming that this eight blade fan has the potential to move more air, if we simply attach it to the stock motors, we have more flow, right? Wrong! The Lucas motor for the Pantera can't even turn the 4-blade fans fast enough to flow enough air. Putting on a 'heftier' and heavier fan will slow down the motor, not to mention overloading the motors. (The motors are rated only at 5 amps.)

Some "eight-blade" fans actually have blades that are shorter and roughly half the width of the stock ones. This change is not really a change.

SOLUTION 3:

SUPER 'TRICK' REBUILT MOTORS

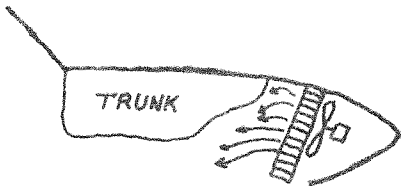


STOCK
(BRUSHES WEAR - REQUIRE REPLACEMENT)

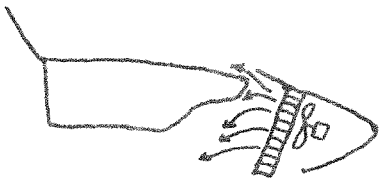
SUPER 'TRICK'
(COMMUTATOR WEARS - MOTOR RUINED)

SOLUTION 4:

VENTED HOOD [FIBERGLASS]



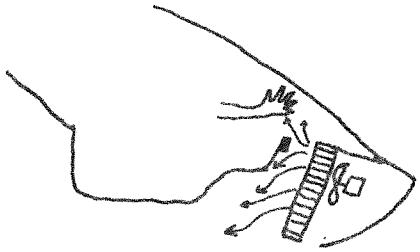
STOCK



VENTED HOOD

PROBLEM:
Since stock motors are not known for their long life, one firm's solution was to install harder material brushes to increase brush life. The motor doesn't turn any faster and has no more torque (twisting force or power) than otherwise. Although the brushes wear very little, the commutator now wears. (In generators, starters, and motors, fan or otherwise, the commutator's material is always harder than the brushes.)

PROBLEM:
The purpose of this item is to release trapped air from behind the radiator. (In the July '76 issue of Pantera International, we mentioned that we at Mind-Train were planning on developing just such an item. We later abandoned the idea when, during testing, we learned that the temperature drop was a nominal 7^{o} F at idle. (You can test for this by running your Pantera with the front deck lid open.) The fact is that since such little air is actually pushed through the radiator by the stock fans, this vent wasn't necessary. If you open the front deck lid and place your hand in the area where the vent would be, you will feel air flow. The majority of the flow, however, is directed to the bottom (where there is a large opening). Closing of the stock hood simply redirects this small



TESTING W/ OPEN DECK LID

amount downward. This vent allows easier escape but doesn't significantly increase flow <u>through</u> the radiator. At speed, Panteras shouldn't overheat anyway, so this vent isn't necessary then either. The true advantage is only in the modest weight loss (roughly 33% depending on construction).

In closing, we have seen how some "solutions" may not really be solutions at all. Vented hoods reduce the temperature by only about 7^{o} F at standing idle; rebuilt motors may save brush wear, 8-blade fans are questionable (when used with stock motors - here the blades being the critical factor, not the number of them); and heavy duty radiators have their own problems, that is, you'll probably need a high flow fan kit like ours!

Our hurricane motors cool the water temperature by 30^{o} <u>or more</u>. If our bolt-on kit doesn't <u>solve</u> your overheating problem, we'll refund your money.

SUMMARY

A new type automotive ignition system has been developed. The user of this new system can expect the following benefits:

(a) Elimination of the need for tune-ups. (Minor ignition adjustments at 40,000 mile intervals will still be required.)

(b) Approximately 15% increase in gasoline mileage.

(c) Marked improvement of engine power and smoothness of operation.

(d) Marked improvement in the ability to reliably fire spark plugs that have become fouled or loaded from:

1. Around-town driving
2. Flooding
3. Oil deposits
4. Carbon deposits

(e) Marked improvement in the ability of a cold engine to start quickly and run smoothly even with reduced choking. This results in longer battery and starter motor life.

(f) Marked improvement in high rpm engine performance with no decrease in spark energy to 10,000 rpm.

I. BACKGROUND

(A) Operation of Conventional System

The high voltage needed to arc the spark plug gap is generated by exactly the same method on all major brands of American automobiles and in virtually the same manner in all "transistorized" ignition systems. This method consists of closing a switch ("points"), which allows direct battery current to build up in the primary side of a transformer ("coil"). Upon opening the switch there is a rapid collapse of flux in the core of the transformer which induces a high voltage (about 20,000 volts) in the transformer secondary. This high voltage between the electrodes of the plugs generates the ignition spark. However, this so-called Kettering method, in use approximately 40 years, has these inherent disadvantages:

1. As engine rpm increases the output voltage from the coil decreases, thus less spark voltage is available. However, the spark voltage required does not decrease, which results in a high-speed voltage deficiency. The effect is more obvious as the points and plugs wear out, i.e., when the engine needs a tune-up.

2. All automobile systems supply direct current into the coil primary. As with all transformers, the coil would work much more efficiently using alternating current. The inefficiency shows itself as heat dissipation, high values of input current, and high wear rates on points and plugs.

In addition to the above inherent disadvantages of the Kettering system, there are these practical disadvantages:

1. Switching off current through an inductor subjects the points to excessive wear and, if left unprotected, the points can burn out in less than one mile of driving. To partially protect the points, a capacitor is connected in parallel with them. This allows the points to work as a reasonably good switch for about 5,000 miles of driving, but at a cost. The current in the primary no longer stops as rapidly. Consequently, the flux collapse is not as rapid and the secondary voltage is not as high. Also, the build-up rate of secondary voltage, commonly called "rise time", is not as fast. Rise time of secondary voltage is important because carbon and grit build up on the spark plugs and allow the charge, placed on the spark plug for arcing, to leak away. If this condition (slow voltage rise time and rapid charge leakage) becomes severe enough, the spark plug gap does not permit arcing and, consequently, the gasoline does not ignite.

2. The generation of the ignition voltage is a cyclic operation. Current slowly builds up in the coil primary, the points open and the current which had built up stops rapidly. The rapid decrease in the current produces the ignition voltage. The points close again and current again slowly builds up in the coil, only to be rapidly stopped as the points reopen. Because of this inherent characteristic,

if the points were opened and closed too frequently there would be an insufficient length of time for current to build up, and low current, when the points open, implies a low value of ignitition voltage. Unfortunately, the frequency with which the points must open and close is proportional to engine rpm. When a car is brought for a tune-up the mechanic sets the points at a compromise. He compromises between letting them stay closed as long as possible, to allow maximum current build-up, and opening them as far as possible to allow the fastest current interruption upon opening.

3. A similar compromise in settings occurs with the spark plug gap.

4. When the points open and interrupt the current in the coil, extremely high voltage is impressed on the points. This high voltage causes arcing, which results in point wear.

(B) Comparison Between Conventional and New System

The new ignition system works on an entirely new concept designed to eliminate many of the drawbacks of the Kettering system. They are:

1. Current no longer has to build up in the coil. In the new system the spark energy is generated in micro-seconds by solid-state components and not by decreasing current in the coil. Therefore, this new system can deliver sparks of consistently high voltage at all engine speeds up to 10,000 rpm.

2. The new system feeds only alternating current to the coil primary. The substantially increased efficiency gives much longer plug life, very low values of starting current and a cooler running, longer lasting coil.

3. The points would be used as a reference only. They would switch less than 1 amp into a pure resistive load as compared to switching 3 to 4 amps inductive load as they do in a conventional system. This increases the electrical life. Mechanical considerations, however, do not allow limitless point life, although a point life seven to ten times as long is possible.

4. The only part of the point cycle which this new system looks at is the instant of point opening. How long they remain open (i.e., dwell angle, dwell time, point gap) no longer affects the spark or engine performance. The points cannot get out of adjustment because any gap allows the engine to perform equally well. This eliminates the need for the car to be "tuned-up."

(C) 40,000 Mile Ignition Maintenance

This new system requires no maintenance. If properly secured and connected it should last indefinitely, unattended. Unfortunately, the same is not true for the other parts of the ignition system. In any event, it is unlikely that any ignition part will need attention in less than 40,000 miles. The only exception would be a case where the engine is burning so much oil that the spark plug electrodes become completely obscured from the oil deposits, or when the bushings on the distributor are so worn as to allow large amounts of oil to coat the rotor and inside of the distributor cap.

Turbo-Pantera

In this short dissertation, we will simply tell why we built our MIND-TRAIN TURBOS as we did. There is no rational reason for a 600 hp Pantera capable of 200+ mph, so there is no reason to try to convince you that "you need one." For sure, a turbo Pantera is unbelievably quiet, but no one can justify spending $3000 for a "muffler system." However, if we cannot talk you out of it and you still feel you need a Turbo Pantera, read on.

We chose to use two turbochargers rather than one because it is more efficient to use two turbos. In order for a single turbocharger to handle the same airflow as two smaller turbochargers, the compressor and turbine blades must be larger in diameter. Thus the single Turbocharger cannot accelerate as quickly as the two smaller turbochargers and throttle lag is the result. Adding to the throttle lag of a single turbo installation is the fact that longer exhaust tubing is required to connect both exhaust manifolds to the single turbocharger. Again, a loss in total throttle response is the result. Also, from an aesthetic point of view, there is no denying that a twin turbo setup has more sex appeal than a single turbo installation.

We chose to have the carburetor mounted ahead of the turbocharger rather than blowing through the carburetor. In this way, carburetors can be changed at will without having to use special carburetors modified for turbo use. Also, by using a directional flow gate (built into our Control Chamber), it is possible to let the air/fuel mixture bypass the turbochargers during the periods when the engine is not running under boost.

The cross-sectional area of the turbocharger compressor is very small in relation to the size of the carburetor, and the air passage through the turbocharger is actually a severe restriction until the turbocharger has built up enough speed to pressurize the intake manifold. This adds to "turbo lag." Our Control Chamber allows the air/fuel ratio to bypass the restrictive turbochargers (for better throttle response) until the turbochargers can add to the engine's performance. In essence, our Control Chamber allows for a smooth, responsive change from the normally aspirated (i.e. compressor bypassed) to the turbocharged modes. Thus, no hesitation nor turbo lag.

We have selected turbochargers from the aerospace industry that utilize "Quick-Change" V-clamps rather than the industrial bolt-on types also available. These "Quick-Change" turbine housings allow you to easily dial-in the exact boost you want. Roughly speaking, each pound of additional boost pressure is equivalent to an additional 20 hp on the Pantera. Running with only 15 pounds of boost will add approximately 300 hp to the Pantera (600 hp total). With 30 pounds of boost, you will have around 900 hp! Now the problem is finding someone who can build you a Cleveland that can withstand 900 hp.

For mufflers, we have naturally chosen our "Big Throats," easily the most free-flowing system on the market. Since each pound of exhaust backpressure is equivalent to a loss of two pounds of boost pressure, it is easy to see why we wanted to use the least restrictive system available. As little as two pounds of exhaust backpressure will lose you 80 horsepower!! Our "Boost Limiters" can be easily inserted into the chrome muffler tips on the "Big Throats" mufflers to fine tune the backpressure to limit the ultimate boost and horsepower.

We have selected a very low profile Corvette air-cleaner for our turbo kits. With hood clearance being a critical factor on front-engined Corvettes, the super low profile combined with a high capacity filtering element (designed for 454 cubic inch engines) is just what is needed. You will still have to slightly dimple the center of the stock air screen over the air cleaner wing-nut.

The Holley carburetor supplied in our kit is selected for the type of driving you do and the amount of total boost and horsepower desired. Again, we believe that the best means to control your boost pressure is with fixed restrictions such as carburetor sizing and tailpipe restrictions.

The Edelbrock aluminum hi-rise manifold was chosen for its light weight and because its smaller passages operate on a higher mixture velocity for better throttle response.

The polished valve covers have stainless steel Aeroquip oil return lines from the turbochargers.

We have included a Jacobs high energy C.D. ignition system. This ignition system is currently the only one to incorporate a mini-computer to modify the spark for each cylinder according to its own requirements.

Since turbocharged engines tend to run about 10^{o} hotter than normally aspirated engines, we have included our "Hurricane Fan/Motors" in the complete package. It wouldn't be too much fun having a turbo Pantera (or any Pantera, for that matter) if it overheats all the time.

Because our Turbocharger kit locates the turbos above the valve covers, you will be able to retain the fiberglass rear trunk in its entirety.

Everything needed for the changeover is included in our complete kit. Our complete Turbo package is a bolt-on to the Pantera. No cutting of body panels is required. However, you will have to relocate the water tank mounted on the right fender panel. This allows the Turbo tailpipe to pass down in front of the inner fender. Total installation time should be about 25 hours or less.

TURBO

SPEED LIMIT 1000

.... the art of flying on the ground!

BY JOHN CHUNG

INTRODUCTION

Turbochargers are commonplace when it comes to aviation; but they're quite rare, as everyone knows, when it comes to the automobile. With the exception of the Corvair Spyder, Turbo Carrera, and some race cars in the land of Mega-Bucks, turbos haven't seen the underside of many hoods. It's precisely this rarity that makes turbos, without a doubt, the most exotic "goodie" for any car.

In this article, the first of two parts, I will explain how a turbocharger works and outline some of the things we have learned in our own attempts at turbocharging our Panteras. The next article will deal with detailed theory and test results. It is hoped that these two articles will help you better understand the art of turbocharging. Should you decide to turbocharge your own Pantera, the information herein will be very helpful in attaining that goal successfully.

We at Mind-Train first became involved with turbocharging back in 1973 when we race-prepared our 1972 Pantera for competition on the Bonneville Salt Flats. Instead of transporting the car, via trailer, to the race location at Wendover, Utah, we wanted to be able to drive the car there. Driving to the Salt Flats hadn't been heard of in years—all other cars had to be towed or trailered. With the amount of work and time necessary to prepare a race-engine for a once-a-year event, nobody was willing to waste that on simple driving. After all, some "trick" competition valve jobs are only good for about 200 miles of street driving. For the sake of uniqueness and simple "mind-blowing," we wanted to set a record with a "street car." Turbocharging was the only answer.

Turbocharging a car, in itself, will not make a car "unstreetable." It is perhaps the only way one can double the horsepower output of his engine without sacrificing low to mid-range power. To see this, we must first understand how a turbo works.

CHARGING

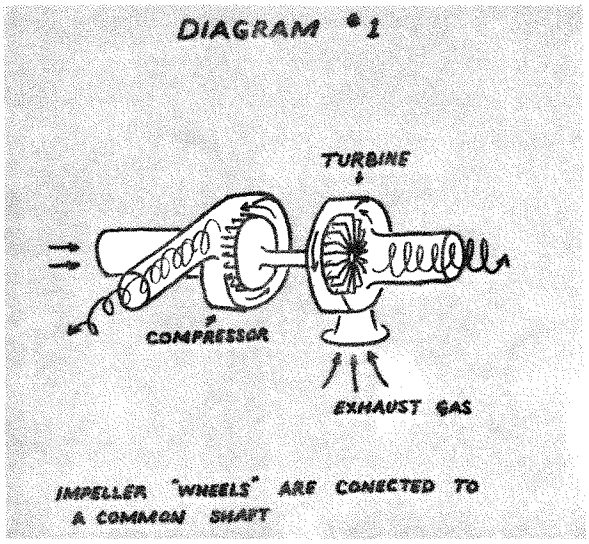
BASIC THEORY

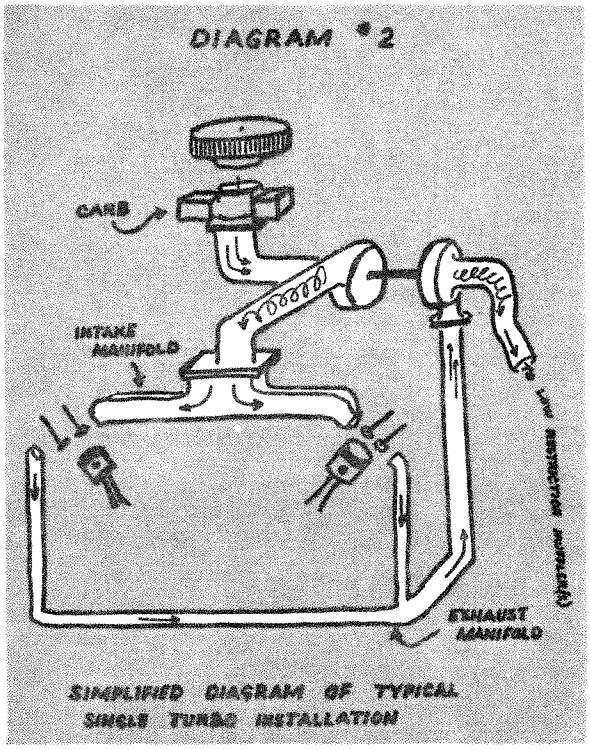
To completely understand the design and applications of turbochargers, a degree in physics is required. The basics, however, are relatively simple.

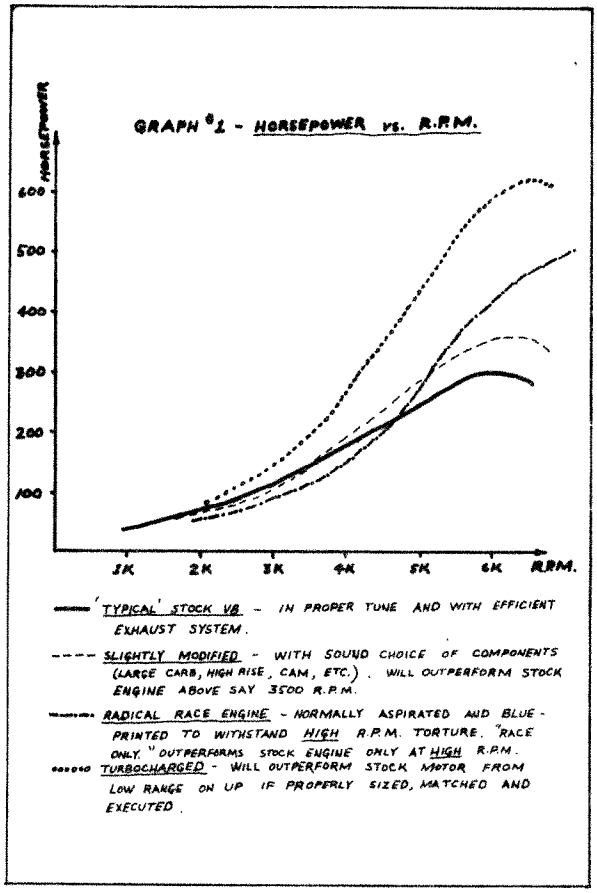
A turbocharger is really nothing more than a sophisticated air pump or compressor that is driven by exhaust gas flow. (See diagram 1). This compressor is used to pressurize and thus *force* the air/fuel mixture into each cylinder. The more air/fuel mixture fed to each cylinder, the greater the output of the engine. Also, it is important to note here that since the turbocharger obtains its power from exhaust gas flow, the greater the exhaust flow, the greater the compressor output, or boost. (See diagram 2.)

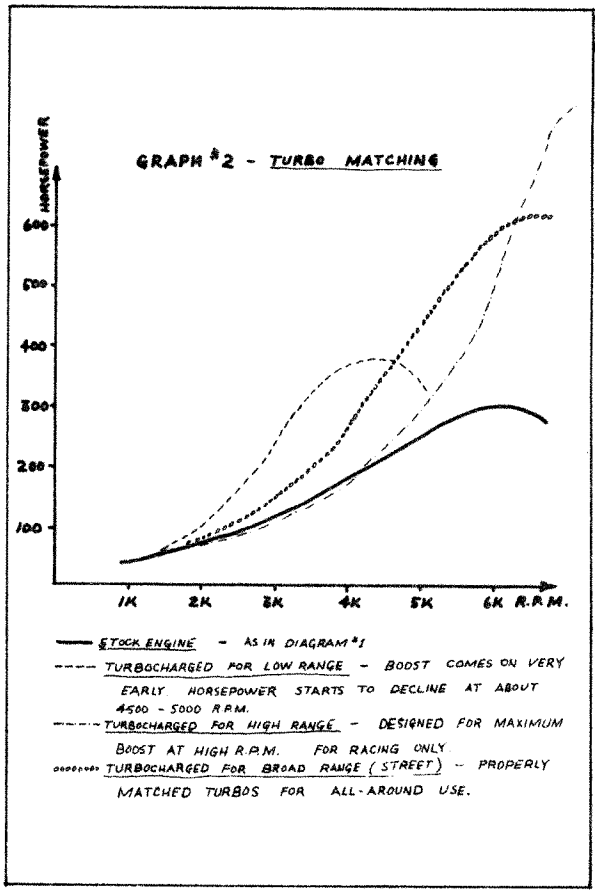
Since engine output is directly related to the amount of air/fuel mixture it can burn, this boost (or pressure over atmospheric pressure) can greatly increase the output capabilities. (Atmospheric pressure = 14.7 lbs. per sq. in.) With a boost pressure equal to atmospheric, the "absolute" pressure would then be *twice* that of normal (or 14.7 lbs.) atmospheric + 14.7 lbs. boost = 29.4 lbs. absolute). And since the doubling of the absolute pressure would feed twice as much of the vital air/fuel mix to the engine, a 100% increase or doubling of the horsepower would result. Likewide, if one can obtain 30 lbs. boost, there will be a 200% increase or tripling of horsepower! Some Offy engines operate at up to 50 lbs. boost for short bursts. But before any of you start dreaming of Panteras with 1200 hp, there is something else you'll have to contend with and that is DETONATION. (More about detonation later.)

Also, unlike superchargers or blowers that are mechanically driven via belts or gears, this boost is present only when there is sufficient load on the engine (i.e. hard acceleration with foot to floor). This is true since sufficient exhaust gas flow is necessary to actually pressurize the intake manifold. For example, when you are cruising at say 40 miles an hour on a level road, the engine is under very little load. Your gas pedal is depressed only slightly and consequently relatively little exhaust flow is present. Let us now suppose that you floor the pedal. Since the engine is now trying to accelerate the car, it is under more load. And since the engine is now burning up a lot more gas (remember, your pedal is to the floor), there is more exhaust gas flow. It is only under such circumstances (heavy loading) that the turbos create boost and give you that kick-in-the-pants acceleration. During normal driving, the car behaves like a normal, non-turbocharged car with none of the inherent low to mid-range loss of power experienced with modified intake systems (carb and manifold) and/or camshafts.









TURBOS FOR BONNEVILLE

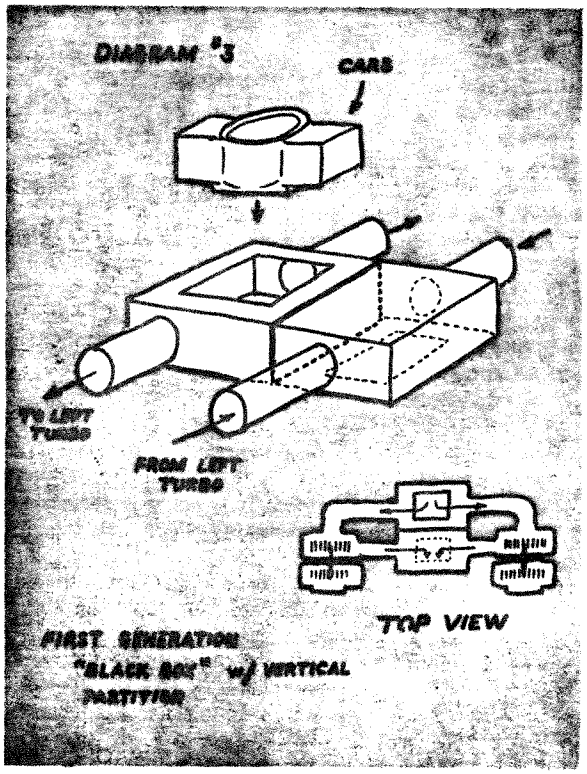
There are, of course, various sized turbocharger units available for the different applications (tractors to airplanes). By size I mean flow capabilities, compressor and turbine housing size, etc. After considerable research and varying opinions, we decided to use two turbochargers. The use of only one unit (depending on size and mfg.) often *limits* the output of the engine above say 4500-5500 rpm. Since we were planning on revving the engine to 7000 rpm at Bonneville, a limitation was the last thing we needed. Also, there is an advantage in using two smaller turbos than one large one. It has to do with the greater total moment of inertia of the larger impeller as compared to the smaller ones, but we'll leave that theory for the next article.

Now that it had been established that our Pantera was to be twin-turbocharged, the next important decision was the location of the various components. There are some very important practical considerations that must be observed in any automotive turbocharging attempt. They are as follows:

1. Will the turbo(s) suck through or blow into the carb(s)? We chose the former.
2. Path between carb and compressor (in the case of sucking through the carb) should be as short as possible.
3. Path between carb and compressor should *not* be uphill.
4. Distance from compressor outlet to intake manifold should be at a minimum, and any uphills must be avoided.

Items 2 through 4 must be followed as best as possible to eliminate both throttle lag ("characteristic" and often annoying hesitation found with most turbo installations) and fuel puddling (fuel droplets falling out of suspension and collecting at a low spot).

To facilitate adherence to the above rules, we devised a "black box" for our Pantera, (See diagram 3.)



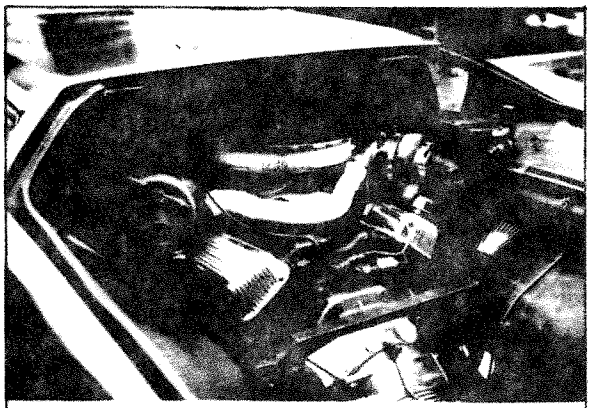
As for other modifications to the motor, only the carb, cam, lifters, valve springs, and pushrods were changed. The bottom end was left completely stock and the cast pistons were not replaced with the stronger forged versions. (By the way, static compression must be 9.0 to 1 or lower for turbocharging.) For street turbo applications, the cam need not be replaced. As a matter of fact, a radical cam will hurt the performance of a turbo.

The reason the bottom end and pistons were kept stock is simple. We were actually testing the reliability of the turbocharged engine for our own info and for the future. Our aim was to eventually develop a bolt-on turbo kit for the Pantera. What could be a better test of reliability than an all-out *constant* acceleration on a 2.5 mile or 5.0 mile run.

As it turned out, a simple oversight (loose hose clamp) kept the record from us. During the qualifying run, the compressor inlet hose fell off and the car simply coasted. At the 1.5 mile marker, the Pantera was traveling over 190 mph on damp salt. Actual timed top speed during driver-licensing runs was 169.17 mph. (See P.I. News Vol. 1, No. 1.) Even though the record wasn't broken, we were thoroughly convinced that turbocharging was the way to go. There were no liveability or detonation problems experienced; so we simply changed tires, hooked up the trailer to the rear of the Pantera, and drove home.

Further "streetability" testing was done and we determined that fuel puddling was occurring during "slow around-town" driving. Upon hard acceleration, the fuel that had collected below the carb was sucked into the compressor. This resulted in an over rich mixture. The problem could have been solved had we built a water heated jacket around the black box, but we decided on another solution.

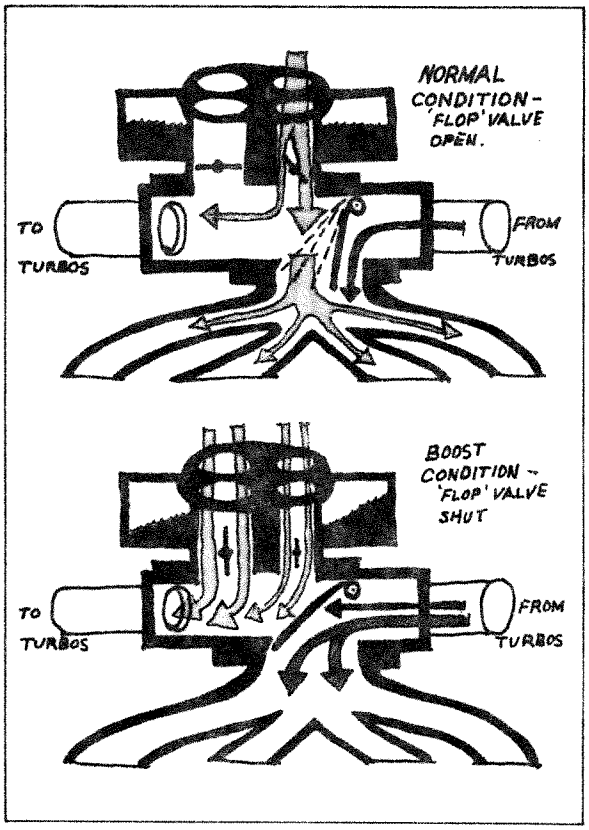
Lack of time, once again, forced us to rush for the next Bonneville meet in 1974. By the third day of the one-week event, we were still in Los Angeles fabricating the exhaust to our new black box. Rather than miss the event altogether, we set aside the turbos, bolted on a dual-quad tunnel ram and drove up again. On the last day, we qualified (exceeded the record). Saturday was reserved for record runs and we set a new land speed record for B/GT by exceeding the old one twice again. Our average speed for the two runs was 172.417 mph. Not bad at 4000 foot altitude where the horsepower output is approximately 85% of that at sea level!



PICTURE ABOVE IS OF OUR LATEST TWIN-TURBO INSTALLATION INCORPORATING THE SECOND GENERATION "BLACK BOX" SHOWN AT RIGHT.

TURBOS FOR THE STREET

We are now testing a new twin-turbo installation that has some unique features. It was mentioned earlier that turbo-lag and/or fuel puddling has plagued most installations. With this in mind and already having experienced fuel puddling, we have come up with the following solution.

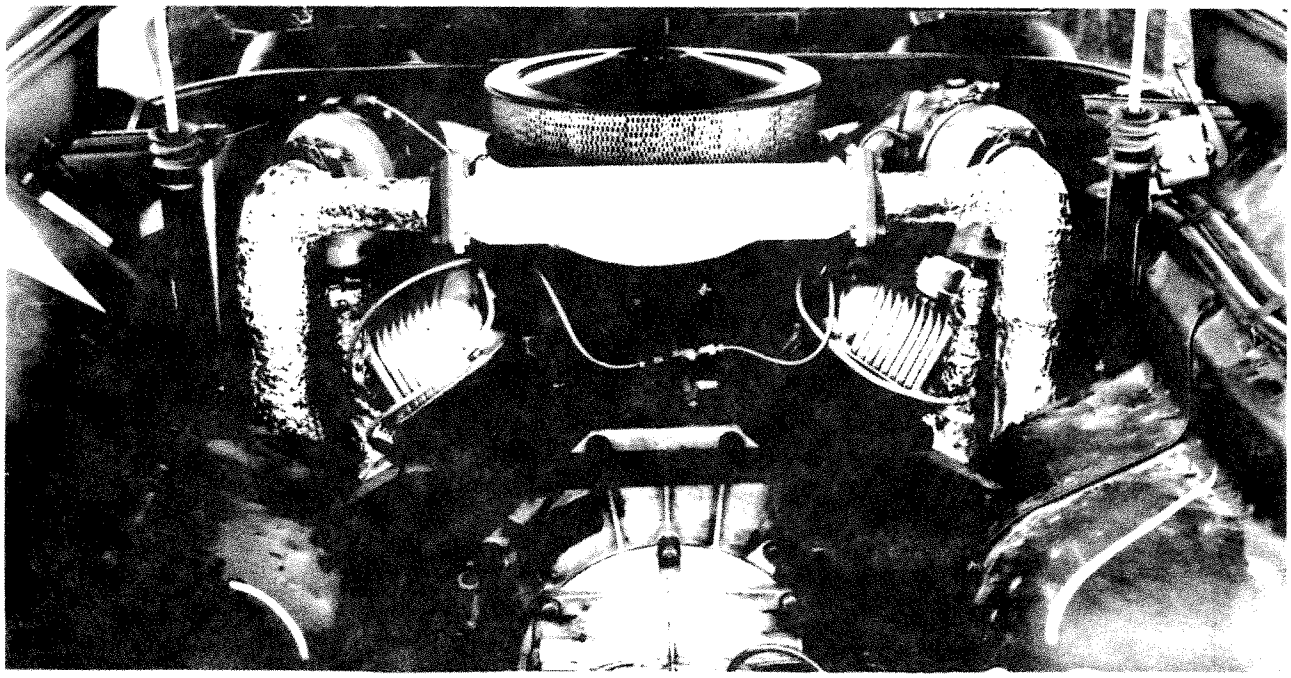


It was mentioned earlier in the basic theory section that detonation (uncontrolled burning due to excessive heat and/or compression pressures) is a prime concern in turbo installations. From our experience and that of a few others, boost pressures of up to 15 lbs. can be handled by today's low-compression (8.0 - 8.5) engines without much problem.

In our first installation in 1973, we utilized water injection and pressure retard to eliminate detonation. This method can be used effectively for turbocharged engines with up to 15 lbs. boost. This means that one can easily double the horsepower without resorting to exotic methods for the elimination of detonation. One such exotic method is the use of an inter-cooler. (Additional details will be given in the next article.)

In closing, I would like to state that turbocharging is definitely the most efficient and practical way to realize large horsepower gains in terms of reliability, driveability, time-money-labor, or any other comparative parameter. Everyone has heard of increasing performance by "hopping-up" the engine. Large carburetors, special intake manifolds, trick heads, radical cams, etc.—All of these modifications help the engine breathe (at top end), but they also hurt low-end performance. Why increase breathing ability? Because the more gas and air an engine can suck in, burn, and expel, the more horsepower and torque it can produce. Turbocharging is just "another way" to accomplish the same thing.

TURBO



This article is a continuation of the one that appeared in the last issue of Pantera International News. The information given in the last issue is important and the article should be re-read to fully appreciate the info given here.

Before we get started, however, let me give you a word of caution. Since the "basics" of turbocharging are quite simple and easy to understand, some people may get the impression that simply bolting on a turbo or two will give them what they want. This applies both to the owner who attempts his own installation and to the "mechanic" who wishes to experiment on a customer's car (fattening his wallet at the same time—regardless of the end result). As is true in many other areas, a little knowledge is often dangerous. Some of you may have heard of people that are disappointed with their turbo setup. A number of owners have contacted me and told me about their disappointments and in some cases about their catastrophic results. Upon close examination, it was determined that there was either an error in "engineering" or execution. Some installations are not only next to worthless, but ridiculous, also—and for five grand? Mr. racing mechanic, how can you sleep at night?

But don't let any of this discourage you. As we continue, you'll learn how to spot some of the common "errors in judgment" and "mythical solutions" often used—even by so-called "experts" in the turbocharging field today. Turbocharging *can* be done properly and if you pay close attention to the points outlined here, you'll succeed with a minimum of mistakes and experimentation.

BOOST PRESSURE

The two primary considerations in *any* turbocharging attempt are: (1) obtaining boost and (2) eliminating detonation. If these two considerations are satisfied fully, you have a turbocharged "STARSHIP." The absolute power is exhilarating (and it feels good, too!). The power is smooth and forceful and the sound can be anywhere from unbelievably quiet (with mufflers) or "whining" loud (without).

In most cases, however, the outcome may fall far short of what one's desires are. Poorly designed systems will necessarily have to compromise. Turbocharging is a field where there are surprisingly few experts that know what they're talking about.

The considerations that must be 'satisfied' are now threefold. You want "enough" boost; boost over a WIDE range (not often discussed in turbocharging chit-chat); and you want it *without* detonation. Operating your engine at full throttle (this is the only time you'll notice the turbos if there's no "turbo lag") and with detonation will cause its self-destruction in no time.

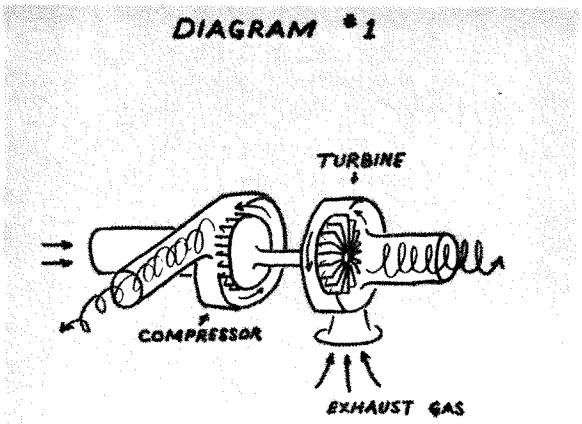
The amount of boost one can call "enough" will of course, depend on how much power increase you want. Remember that 14.7 lbs boost will give you a 100% increase in power. The amount of boost that can be considered maximum "desirable" for a stock street engine will vary considerably depending on who you ask. Our answer is 15 lbs (for the low-compression Pantera). Others may warn you of the consequences if you run with 8 or 12 lbs of boost. Maximum boost without detonation or engine failure is what this article and turbocharging is all about.

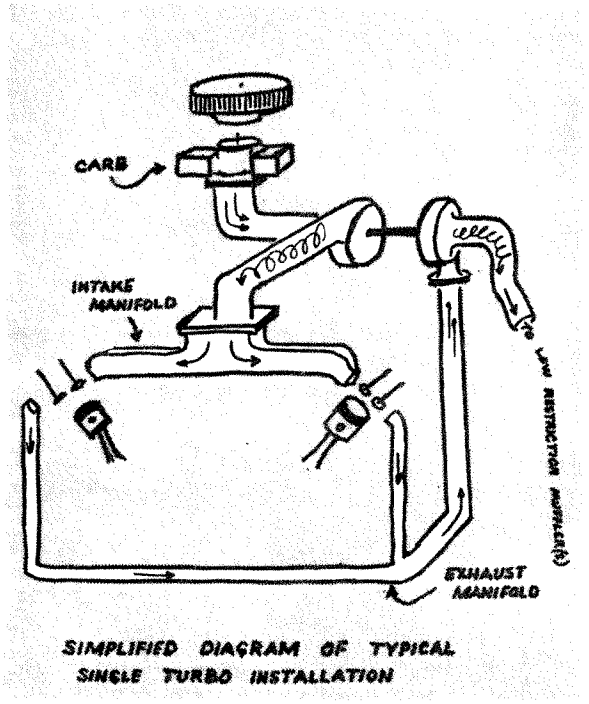
TURBO FEVER

BY JOHN CHUNG

HOW TO GET BOOST

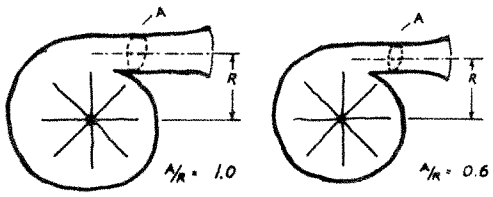
From the diagram below we see that the compressor is powered by the turbine and that the turbine wheel is forced to spin by the *flow* of exhaust gas. The faster we can spin the turbine wheel (and therefore, the impeller), the more boost we can achieve. That is, the compressor's output (boost) is directly related to the speed of the turbine.





Also worth noting here is the fact that once boost has been achieved, the turbine wheel will spin even faster (due to the increased exhaust gas exiting the engine). This, in turn, produces even more boost. The boost will continue to increase (if you're still on the pedal) only up to a point; that is, until design or flow limiters become a factor or until you release the pedal. But more on limiters later.

The speed or more accurately, the range of turbine wheel r.p.m. can be altered in any given turbo setup by the simple change of turbo housings. Diagram 2 shows the basic effect of a change in turbo housing.



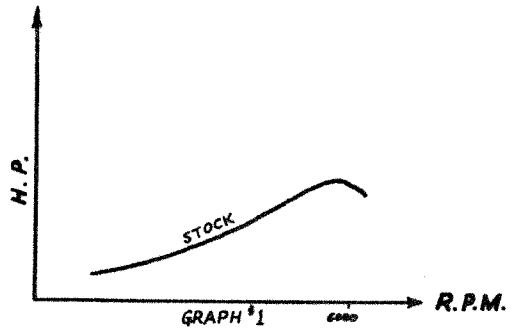
A CHANGE IN TURBINE HOUSING WILL AFFECT THE 'SPEED' OF THE TURBINE WHEEL, THEREFORE, THIS CHANGE IS OFTEN USED TO VARY THE BOOST PRESSURES.

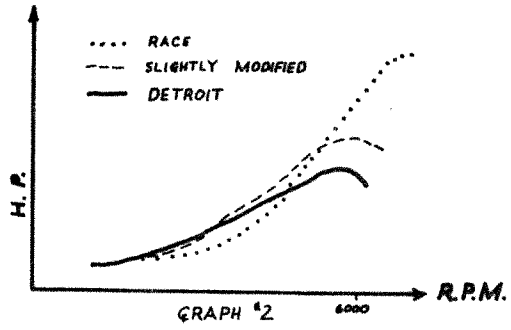
THE A/R RATIO IS ONE MEASURE OF A TURBINE HOUSING AS SHOWN ABOVE. NOTE THAT A 'SMALLER A/R' WILL SPIN THE WHEEL FASTER.

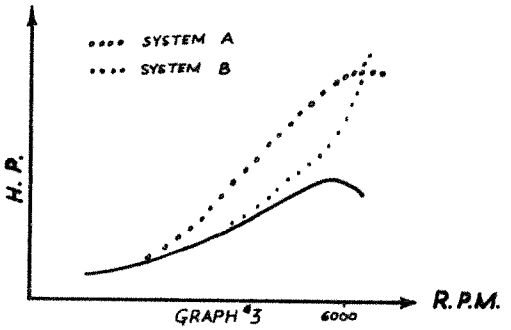
This interchangeability of turbine housings allows us to somewhat control the maximum amount of boost at a given r.p.m. For example, let's say we're developing a turbo system for a small-block Ford. If initial testing shows that we can develop only 5 lbs. of boost pressure at say 5000 r.p.m., then changing to a smaller A/R ratio turbine housing will increase the maximum to perhaps 10 lbs boost (all other factors assumed unchanged). The opposite is also true. That is, if we're developing too much boost to handle, then a change to a larger A/R ratio turbine housing will lower the amount of total boost.

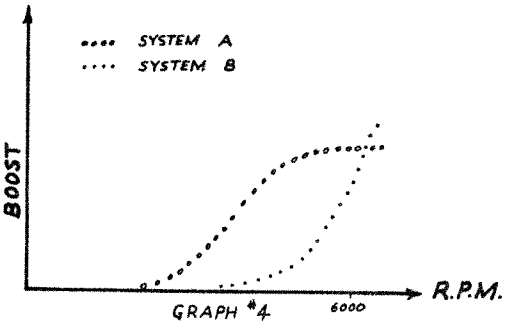
More important than simply obtaining say 15 lbs boost at 6,000 r.p.m. is the range in which boost is obtainable.

Let us see graphically why it would be desirable to have boost over a wide range. Graph #1 shows an example of the common horsepower vs. r.p.m. curve. Note that the redline is not necessarily the r.p.m. at which maximum horsepower is produced (this is especially true with stock engines). The redline is simply a recommended maximum r.p.m. level (usually set by auto manufacturers) above which you shouldn't tread. This is not to say that your engine will blow up at say 7000 r.p.m. (we've often shifted at 7000 r.p.m. with a stock engine—different valve springs and anti-pump up valve lifters). But tread carefully. Blueprinting (disassembly and reassembly of an engine to racing tolerances) will, however, raise the safe range.









Now look at graph #2. Here we see what the curves of a slightly modified (properly) and race engine look like. Note the loss of horsepower in the mid-to-low range with the race engine. Any of you who have an engine like this will know this to be a fact. The engine "comes alive" or starts to really "scream" at say 3500 or 4000 r.p.m. Below that, on the other hand, the engine is a pain.

Graph #3 shows two turbocharged engines compared to stock. It is obvious here that system A is more desirable than system B. The reason system A shows an increase of horsepower "earlier" than system B is because system A delivers boost earlier.

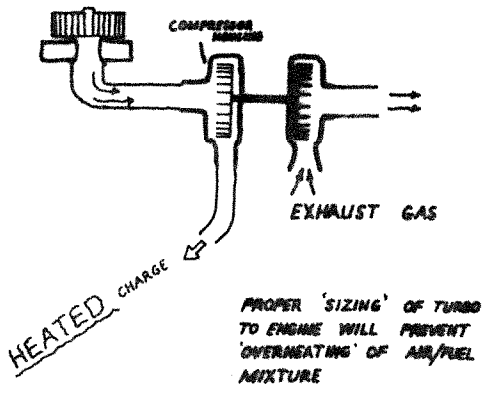
Graph #3 shows boost vs. r.p.m. for systems A and B. Although both setups will produce 15# boost at 6000 r.p.m. (and have double the horsepower at 6000 r.p.m.), system A will outrun system B because of the fact that boost and hence power increase comes on earlier.

Please note that much of his discussion has been simplified. For example, in the above discussion on boost vs. r.p.m., no mention was made of what *gear* the car is in. As mentioned in the previous article, boost is achieved when the engine is under load. Well, in a high gear the engine is under more load. That is, maximum boost achieved at 6000 r.p.m. in an accelerating run in fourth gear only, will be greater than a run in first gear only. Now to confuse you even more, what if one starts from a standstill and blasts through each gear one by one? Since the boost pressure obtainable is directly related to the speed of the turbine wheel, each rush to the redline in the respective gears will speed the turbine wheel more and more. Hence it is quite possible to obtain say 20 lbs boost at the top of fourth at the drag strip while only being able to pull 12 lbs boost at the top of fourth, otherwise. Proper design and engineering is a must if the engine is to perform properly and *reliably* under any possible conditions.

DETONATION PREVENTION

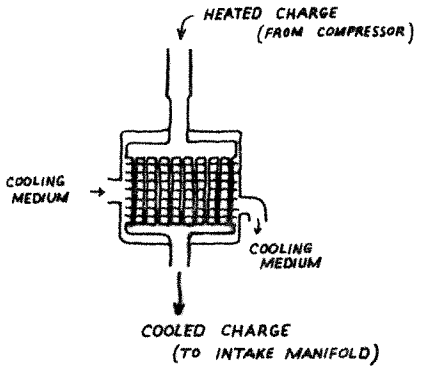
Many are under the impression that simply limiting the amount of boost prevents detonation. There's much more to it than that, as wel shall now see.

We will first deal with that necessary evil peculiar to both supercharging and turbocharging. That is the HEATING of the air-fuel mixture caused by its compression. The more we compress the gas before it enters the intake manifold, the hotter the gas will become. And the hotter the mixture, the more likely you'll encounter detonation. Because of this fact, an important consideration is the choice of proper flow-range (size) turbos (not to be confused with different A/R ratio turbine housings).



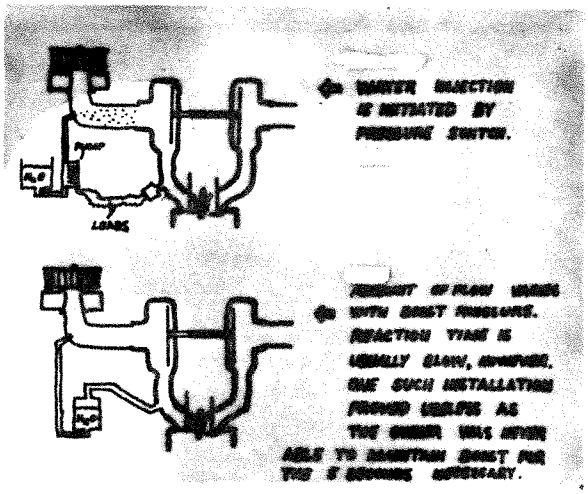
The choice of the proper flow-range turbos will minimize this charge heating of the inlet charge. This is due to the fact that the efficiency (ability to compress without excessive heating) depends on flow into turbo and pressure (and hence density) out of the turbo. Each particular turbo is designed to be most efficient at a certain flow/pressure range.

There are a number of ways to cool this charge, one of them being the use of an intercooler. An intercooler is basically a heat-exchanging device which works on the same or similar principle that the water radiator does. The radiator cools the water and the intercooler cools the air-fuel charge. Intercoolers, however, involve a lot of plumbing, space, and expense and are usually seen only on turbocharged engines that use a great deal of boost.

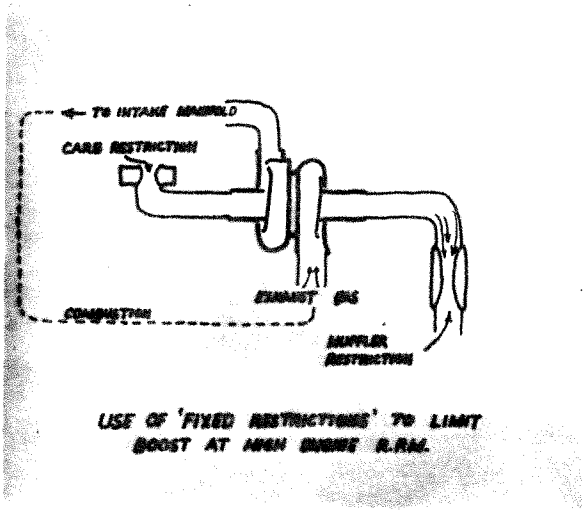


SIMPLIFIED DIAGRAM OF AN INTERCOOLER

Another method that is used to cool the charge is the injection of water and/or methanol. This is usually done at or near the carb. We are currently undergoing extensive testing to determine the desirability of such a system as it can actually hurt performance if not used properly. That is, it may be advantageous to limit the boost to say 12 lbs (with no detonation, of course) rather than use water injection to obtain or safely use 13 or 14 lbs boost. A carefully metered stream of methanol and water will be more effective (remember, water doesn't burn).

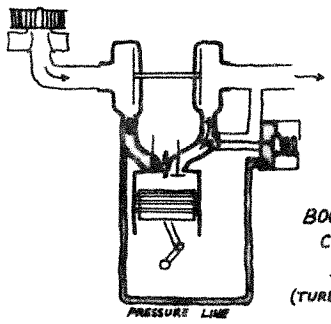


The limitation of boost can be achieved in a number of ways. First of all, the use of built-in restrictors can limit total boost. This restriction can either be in the intake side (air cleaner, smaller carb, etc.) or in the exhaust side (various mufflers, tailpipe diameters, etc.). This method is preferable to the charge to a larger A/R ratio turbine housing mentioned earlier. If you recall the discussion about boost range, you may see the reasoning behind this statement. Let us suppose that on a particular turbo installation using two turbos with .6 A/R housings, boost starts at 2500 r.p.m. and rises quickly to an unmanageable 23 lbs boost at 6000 r.p.m. By changing to larger A/R ratio housings you may reduce the maximum boost at 6000 r.p.m. to a reasonable 15 lbs but you'll also affect the boost range. Boost may now not come in 'till say 3500 r.p.m. A better solution would be to restrict the flow with say a smaller air cleaner and mufflers. These "restrictions" will not actually affect boost or flow except at high r.p.m. (the point where you normally encounter too much boost). This way you will be able to have a wide boost range and still not over-boost at or near the redline.



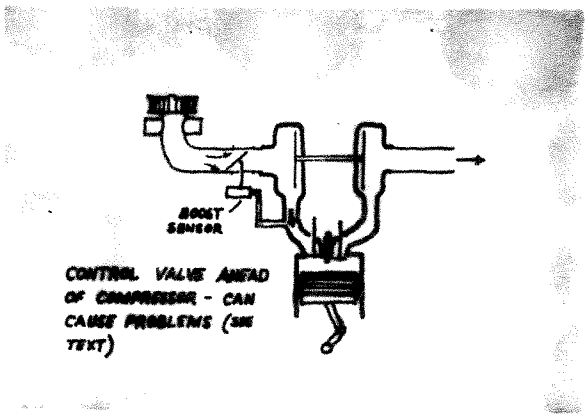
USE OF 'FIXED RESTRICTIONS' TO LIMIT BOOST AT HIGH ENGINE R.P.M.

Another solution would be the use of a wastegate. A diagram of a typical wastegate installation is shown below. This solution also allows for a wide boost range since the turbine housings can be chosen so that boost will come on early. Since this device is subjected to hot exhaust gasses, it must be durable and corrosion proof. The disadvantage with wastegates is the added plumbing, expense, and possible failure of the unit—the consequence being catastrophic, indeed.

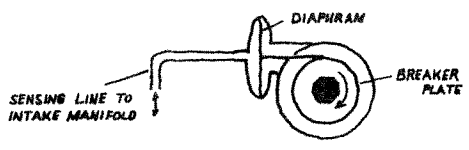


BOOST PRESSURE - CONTROLLED WASTEGATE (TURBINE BYPASS)

The last boost control method to be discussed here is perhaps the least desirable. The diagram below shows the use of a control valve placed before the compressor inlet. The fact that this valve is not subjected to hot exhaust gasses (as with wastegates) reduces the cost factor considerably. The disadvantage is that it is not a good device from a theoretical standpoint. Once the boost reaches a predetermined level, the valve begins to restrict the flow into and thus out of the compressor. The action of such a non-fixed restriction will often lead to the same problems that the excessive boost leads to. In a hard run (as the turbine wheel is being accelerated) this sudden restriction will reduce the flow into the compressor. Since the compressor needn't work as hard under such reduced flow conditions, the turbine wheel r.p.m. will start to increase even more (and so will the impellers). This results in the engine trying to produce even more boost yet controlling the amount at the same time. The higher impeller speeds will further heat the charge and we all know what this heating does. So to offset this added chance for detonation due to excessive heating, the boost will have to be limited to an even lower figure. We see how a poor design may work and how it also necessitates compromising.



Pressure retard is another method often used to help prevent detonation. Diagram 5 shows how this simple system can be utilized. Unfortunately this method is not as valuable as it may seem. From our own testing, we have seen that it does very little (not nearly as much as we had expected). Without pressure retard, we were able to run 11 lbs boost before we experienced detonation. We then ran a series of tests with a pressure retard of 5, 10, 15 and 20 degrees (at the crank) and were able to notice only slight benefits. With 20 degrees regard (18° total advance) at full throttle we were able to run 13 lbs boost without detonation—an increase of only 2 lbs boost. The loss of power due to regarded ignition timing wasn't offset by the additional 2 lbs boost. The injection of methanol and water in the proper ratio is a better idea and will allow pressures of 15 lbs and more without detonation (351 C w/8.1 compression ratio).



VACUUM ADVANCE / PRESSURE RETARD

PLENTY OF BOOST W/NO DETONATION NOW WHAT?

If you, too, can obtain 15 lbs boost with no detonation, then you've got a quiet team of 550-600 ponies all working for you. What more can you ask for? Move aside Turbo Carrera . . . .

Here's a summary of the main components you'll need:

Twin Turbos—Single setup will not work well on the Cleveland. There are two major drawbacks: (1) compressor housing and plumbing will choke the engine at high r.p.m. (SEE GRAPH #2 OF LAST ARTICLE — TURBO FOR LOW END.) The gain in power from early boost will not offset the loss at high r.p.m. (2) large value of moment of inertia (for larger rotating assembly) will result in either throttle lag or slow turbine acceleration or both.

Flop Valve "Black Box"—Similar to one described in last article. A must if you want to *completely* eliminate throttle lag. There is another "box" available with its patented "priority" valve? Look at the size of the valves and note flow path around them before you make a decision. Nickel-size valves are inadequate. Another alternative would be to fabricate a divider box (see last article) to allow short runners to and from turbos. A water jacket should be used with this type of box.

Exhaust Manifolds—These manifolds route the exhaust gasses to the turbines. Extra thick (1/2") flanges should be used to prevent warping and exhaust gas leakage. Any leakage before the turbines will result in lower overall boost pressures.

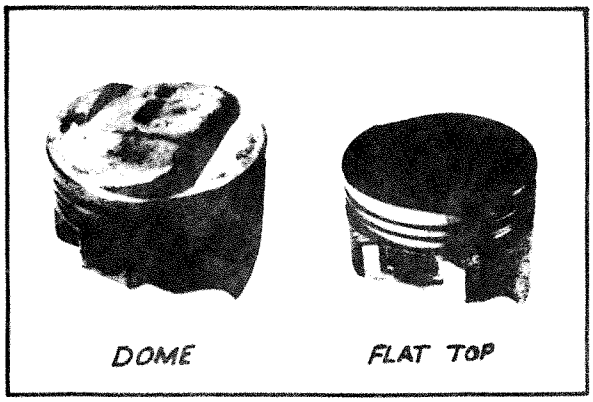
Low Restriction Tailpipe and Mufflers—Turbochargers do quiet an engine. The spinning turbine blades act as a "rotating baffle" and will considerably quiet your engine. You will, however, still need some type of muffling device, no matter what you've read elsewhere. With turbos and mufflers, the reduction of sound levels is startling. By the way, for each additional pound of backpressure in the exhaust system, there will be roughly a two pound drop in total boost.

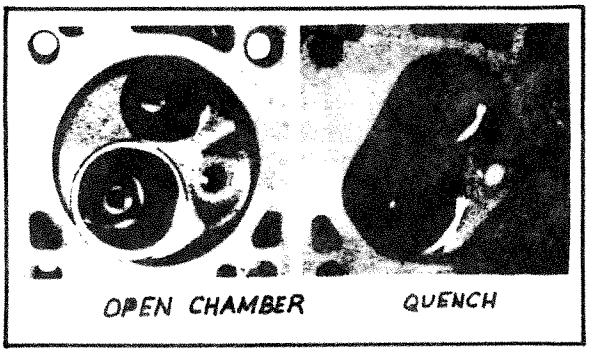
High Energy C-D Ignition—To provide the necessary voltage to fire plugs under higher cylinder pressures.

High Capacity Fans and Motors—To provide additional air flow through radiator at idle and slow speed driving. Turbocharged engines can severely tax a cooling system if you're not careful.

Misc.—We used an Edlebrock Hi-Rise (modified for our own setup) with a Holley 780 in our latest installation. Stock manifold can be used, however. You'll probably want to use a few good gauges (during initial testing, at least) such as a pyrometer (measures exhaust gas temp.), a combination vacuum-boost gauge, a mechanical oil pressure gauge (to check for adequate flow to turbo bearings) and perhaps even a mechanical water temperature gauge for accurate readings (stock ones are junk).

If you're going to go the water/methanol injection route then the stock windshield washer pump may be used. Also, the stock distributor can be modified to provide a few degrees of pressure retard.





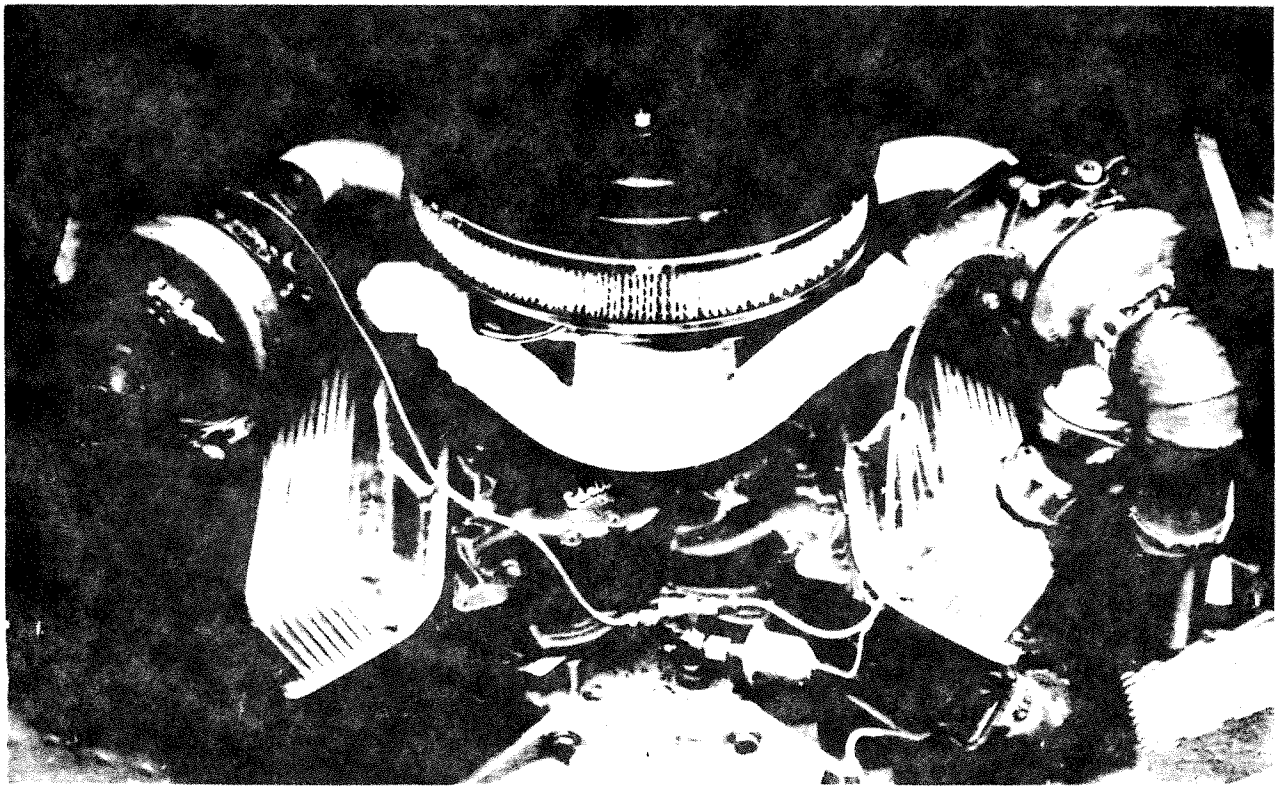
If you have a Boss 351 engine then you'll need to perform a few major changes to take advantage of turbocharging. These engines come with domed pistons (forged aluminum) and "quench" heads for high compression. We know, however, that a low compression engine is needed for turbocharging. There are two ways to go. First of all, you can replace only the pistons with an aftermarket version (might as well get forged ones while you're at it) so that the static compression ratio is dropped to 8 to 1 or even lower (with lower compression you can run more boost). Or you can change the pistons *and* the heads with the later low-compression versions (cast, not forged) from Ford. Changing the heads alone will not make enough of a difference. I would recommend the first method. I would also replace the mechanical lifters with hydraulic anti-pump-up ones, maybe even replacing the cam with a milder one. (You folks out there with the low-compression engines are lucky, you needn't tear apart the engine.)

CONCLUSION

If you know what you are doing (or with the help of someone that does) you'll be able to turbocharge your Pantera without too much difficulty. There's nothing that compares to driving a properly turbocharged Pantera. It's not as difficult as I may have led some of you to believe and the effort is more than worth it. Think about it . . . and drive safely.

The most difficult aspect of writing an article such as this is the method of presentation. Since the backgrounds of P.I. members vary so greatly, it is difficult to use an approach that will be both understandable and informative to all. It is hoped that the method of presentation chosen here did not leave anyone totally lost nor insult anyone's intelligence. If you have any comments or questions, I would sincerely appreciate hearing them. You may write me c/o Pantera Interational. With your help, it will be possible to better prepare, choose, and present articles in the future.

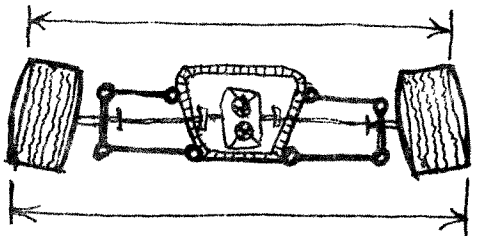
See you all in Hawaii!!



Legs

Uneven rear tire wear of Panteras is a common problem. In fact, this can be called typical on cars that have been lowered to the "European Ride Height" (by removing aluminum spacer under coil spring). This is because the method chosen by the DeTomaso Factory did not have enough adjustment built in to properly align the tires for adequate tire life.

Proper alignment of racing applications calls for negative camber. What this means is that the outside top edges of the front or rear tires are closer together than the outside bottom edges (see figure 1). This



puts more pressure on the inside edge of the tire. However, as the race car enters a corner, it tends to roll (i.e. tilt) and force more weight on to the tire that is on the outside of the curve. Left hand turns will

force the tires on the right side of the car to carry more weight as the weight of the car transfers to the outside of the curve. Centrifugal force tends to also distort the tire tread and the race car tire is now loaded more evenly across the tread width from the inside edge to the outside edge. This even loading of the tire tread in a cornering situation allows the race car to achieve its maximum cornering capability. Remember, too, that racing tires need not last more than a few hundred miles.

On "street" cars, however, "race car" alignment will only lead to premature tire wear because the street car is not always driven to its maximum cornering capability and, as a result, the highly loaded inside edge of the tire tread can be scrubbed away in less than 5000 miles.

Inside tread tire wear is aggravated on the wider low profile 60, 50, and new 40 series tires. In fact, tire wear can be so expensive when figured on a dollars/1000 mile basis that it can exceed the cost of gasoline. In other words, a $500 set of rear P-7's worn out in only 5000 miles costs $100 per 1000 miles of driving. One hundred dollars of gasoline will surely get you further than 1000 miles. And this is not even considering front tire wear!

Camber is adjusted on the rear tires of the Pantera by adding or removing shims from between the lower A-Arm and frame. Unfortunately, many Panteras do not have enough adjustment built in and even with all shims removed, proper "street" alignment cannot be achieved. What must be done is to either shorten the length of the lower A-Arm or lengthen the upper A-Arm. We chose to lengthen the upper A-Arm for two very important reasons:

1) Lengthening the upper A-Arm will widen the rear track width and will help change the Pantera's basic understeering characteristics to a more desirable neutral handling trait. By utilizing the capability of having adjustable rear upper A-Arms (our "legs") and lower A-Arms (lower A-Arms being stock on Panteras), fine tuning of handling characteristics can be achieved. Widening the rear track adds oversteer and narrowing the rear track adds understeer.

2) From a visual standpoint, the rear fender wells on a Pantera look relatively empty and adding to the rear track to achieve proper alignment is better than pulling the rear tires closer together (hence adding more to the empty feeling).

So check your rear tires for inside tread wear. If an alignment cannot solve the problem, our "Legs" are all you need.

SPECIFICATIONS

"LEGS" - $280 pair (complete)

A-Arm	Hi-Strength 4130 Chrome Moly Tubing
Heim Joint	Ball and Socket Stainless Steel. Threaded shaft allows for as much as 2" wider rear track (1" per side).
Capscrew	Allen Head Socket width. Castellated nut.
Jam Nut	Cadmium Plated.

"THE BEST LEGS IN TOWN" - $380 pair (complete)

A-Arm	Polished 300 Series Stainless Steel
Heim Joint	Ball and Socket Stainless Steel. Threaded shaft allows for as much as 2" wider rear track (1" per side).
Capscrew	Allen Head Socket width. Castellated nut.
Jam Nut	Cadmium Plated.