innovations

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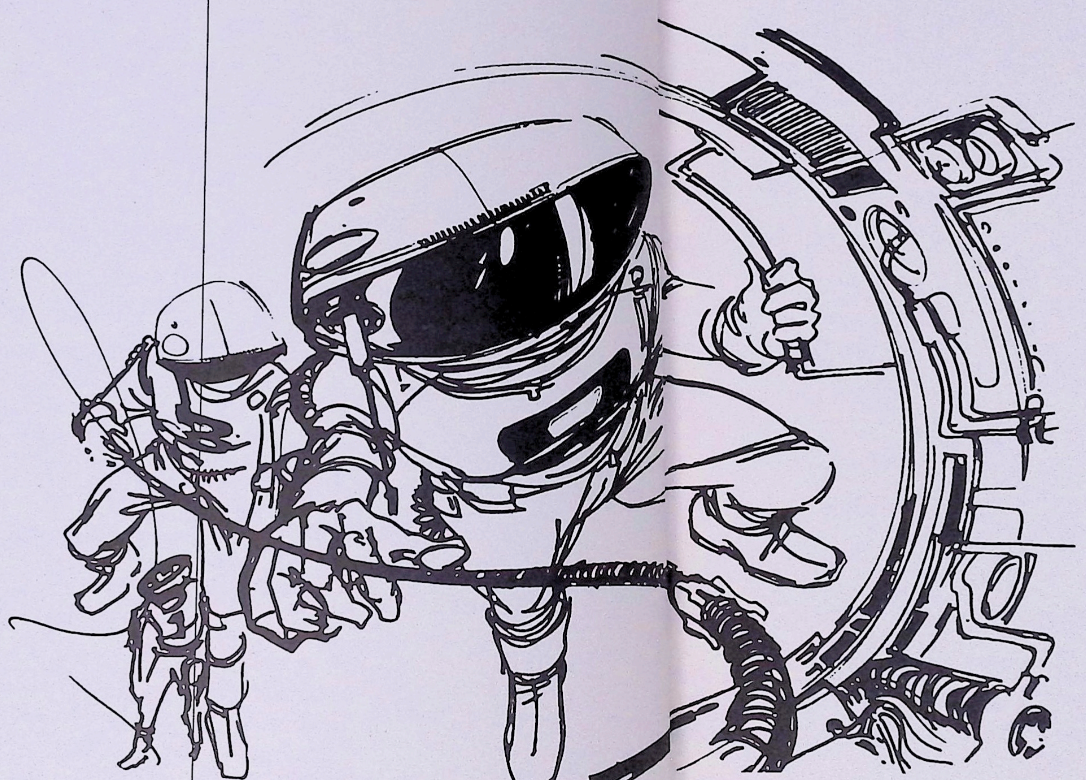
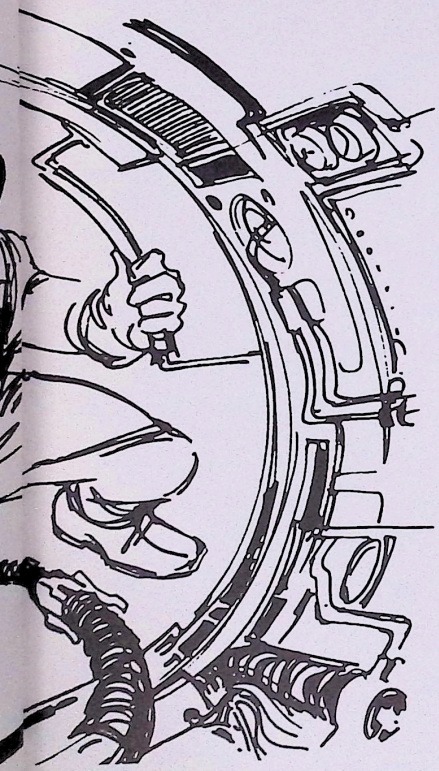
STATEMENT OF INTENT

In the President's files at the White House is a report from the Commerce Department indicating that over the next decade Americans will purchase 90 million new automobiles and 14 million trucks and buses. This projection, which far exceeds our anticipated population growth rate, dramatically emphasizes the expanding role of mobility in the life of our country.

The simple fact is that the automotive industry has added new dimensions to automobile ownership and use, and transformed mere transportation into something broader and more embracing, through the tools of imagination and creativity.

This book has been prepared in the spirit of the innovation that typifies the automotive industry. United States Steel hopes that the ideas . . . the new material concepts . . . and the various developments presented here will serve an important function, and result in solutions for many of the engineering problems that changing personal tastes and stricter performance standards continue to create.





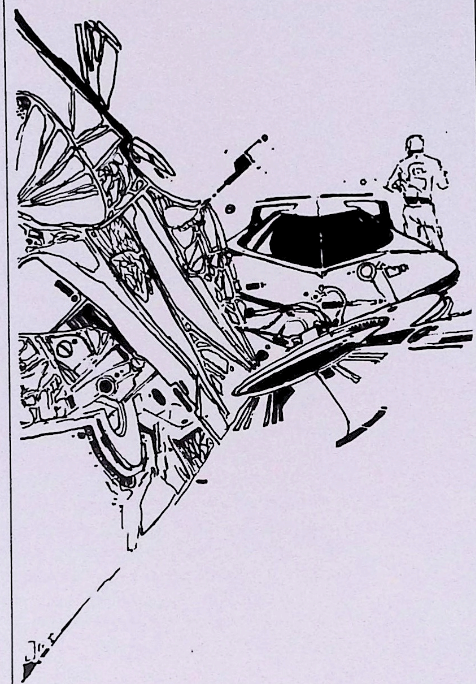
MAN IN MOTION

Less than a generation ago, those who could foresee the momentous changes about to occur in the pattern of family and business life were rare indeed. Yet, the elements were there for all of us to discern and interpret: increased emphasis on technology, a growing population, greater affluence and the increasing role of travel in our scheme of living.

The inevitable result was movement—the movement of rural millions to urban centers, and the paradoxical spread of cities into the suburbs. Airfields, high rise apartments and shopping centers are symbols of this era of man in motion.

Above all, the automobile is the prime ingredient in the recipe for the expanded life, and the day when it could be considered exclusively as a means of transportation has been torn from the calendar. Four wheels and a power plant are now only the basics of the vehicle concept. The modern car is at once: transportation . . . a family gathering place . . . a tool of education . . . a theater of entertainment . . . a symbol of status. As such, its engineering, its styling, its architecture, if you will, has taken on new roles and new responsibilities.

In the light of these demands on the private vehicle it takes no crystal ball to perceive the trend in automobile design —toward increased driving comfort, more efficient fuel consumption, increased adaptability to ever changing uses, even longer performance guarantees and the added emphasis on safety in construction and operation.



THE NEW ERA OF MOTION

What was it like to live in an autoless economy? Only about four percent of our population can remember. In fact, it is likely that no more than ten or twelve percent can recall the start of the automobile age—when there was more horsepower on four legs than under the hood.

The era of motion, really, is new only because it is still developing.

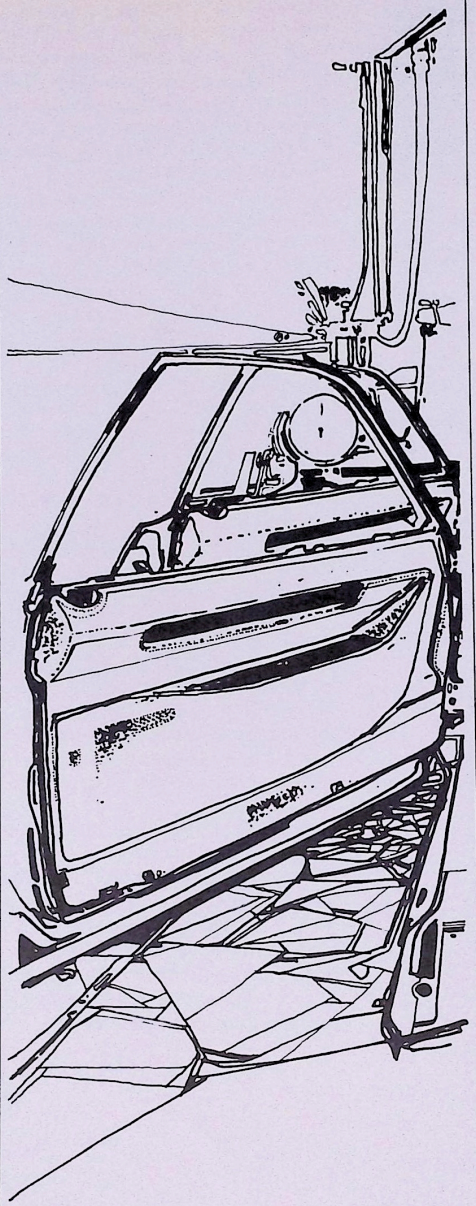
Today well over three-and-a-half-million miles of roads and highways invite us to extend our horizons and broaden our lives. If not another mile were built, today's average motorist would need about 400 years to make a tour of the roads now in existence in America.

Ever finer roads create the demand for faster, safer speeds, higher horsepower, and the design of a package in harmony with the increased time spent behind the wheel and in the passenger seat.

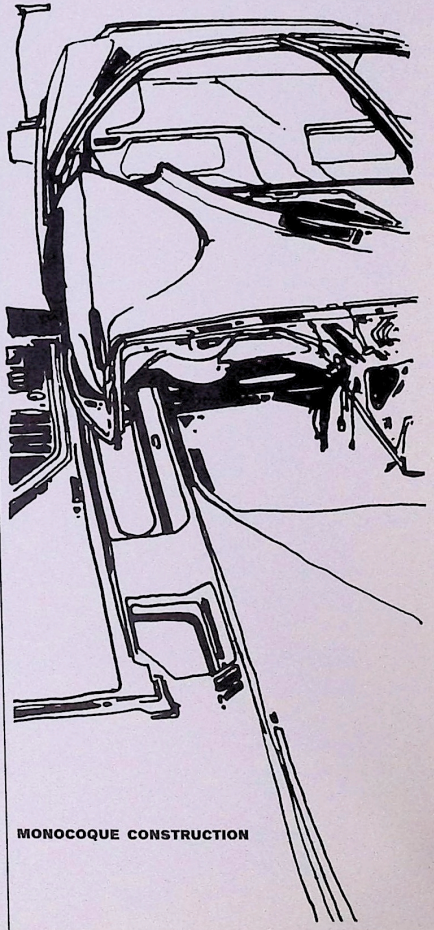
That is why the new era of motion has become the era of new materials and new ways of using the established materials with which the automotive industry has built its world wide reputation for superiority.

Part of this evolution in automotive engineering has been the proliferation of vehicle types—to serve the diverse needs of the market. This added dimension offers exciting opportunities for applying new steels and developing new techniques for utilizing familiar steel products.

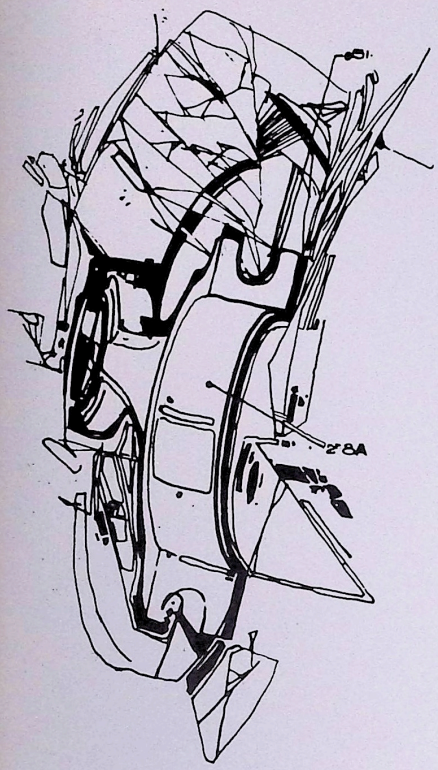
United States Steel—in its laboratories and plants—is devoting increasing attention to the evolving needs of the dynamic automotive industry. On the premise that the best materials can always be made better, the search for improvement is continuous. USS Design Study Projects over the years have shown the merit of this attitude of inquiry.



WIRE MESH INNER DOOR PANEL



MONOCOQUE CONSTRUCTION



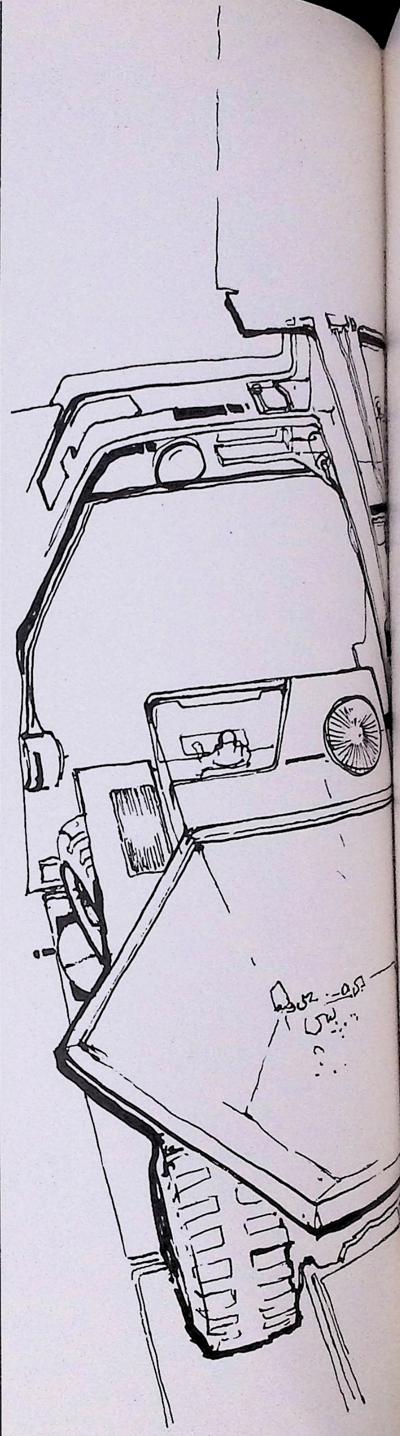
Recognition that steel is the basic automotive material often leads to the false viewpoint that steel has reached its fulfillment, and that the designer must turn to other materials for his innovations, and the "flair" that results in the coveted best seller.

However, this view of steel overlooks the enormous reservoir of steel products, as well as the many research developments now available from U. S. Steel. For carbon steel, the material most often associated with automobile production, is only one member of a sophisticated family of engineering steels—many of which were created expressly to solve the problems of function, form and finish that automobile specialists are required to solve on tight schedule. Some of the more interesting USS products and Design Study Programs covered in this volume are:

- High-Strength Low-Alloy Steels
- Low-Carbon Martensitic Steels
- Sandwich Panel Construction
- Cold Forming Techniques
- Wire Mesh Interior Combinations
- Steel Fiber Dies and Hardware
- Steel-Wire Tire Insert
- Energy Absorbing Structures
- Monocoque Cab Construction and Perimeter Framing
- Photochemically Etched Stainless Steel

The ability of steel to excel in problem areas offers unlimited possibilities for visionary thinking.

COLD FORGED CONNECTING ROD



MOUNTAINS ON THE MOVE

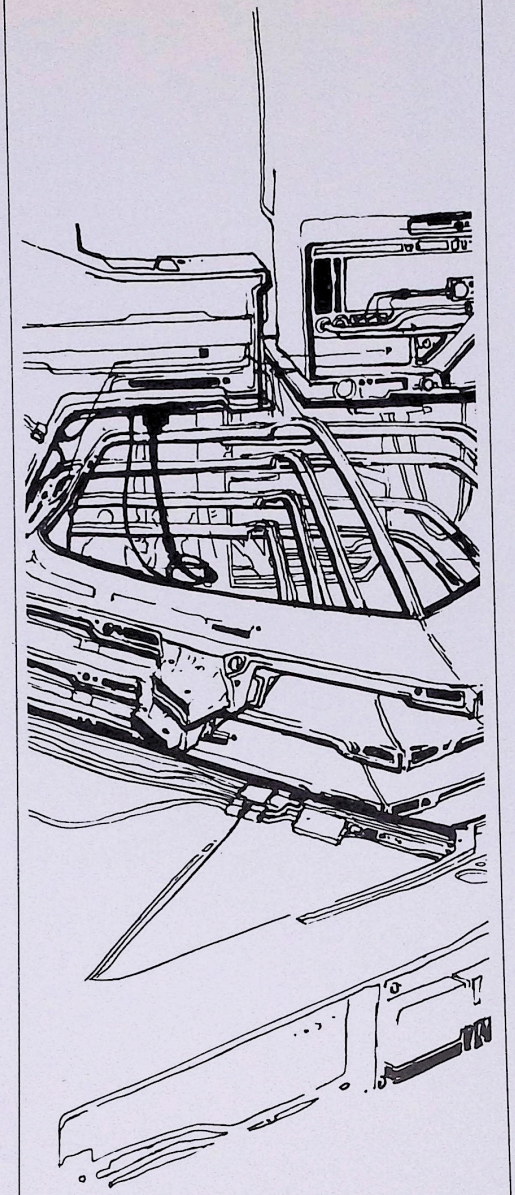
In 1966, almost 24 million tons of steel will be used by America's automotive industry.

On the average each vehicle, as it rolls from the production line, will take its 2-ton share from this great stockpile.

Looking at it another way, from 60 percent to 65 percent of all the material used in the average vehicle is steel in one form or another. The contribution of steel touches all phases of automobile production: framing, power plant, drive line, body structure—as well as providing much of its important esthetics.

For United States Steel, the story of the automobile begins with mountains on the move—several tons of raw material for every ton of finished steel! And, from this beginning, the real contribution of U. S. Steel takes shape: a vast and continuing program of steel research, oriented to automotive needs . . . constant introduction of new processes and systems to maintain the economic and engineering advantages of this indispensable and versatile material . . . scores of furnaces and miles of storage space for the many thousands of steel types and forms.

Keeping steel contemporary involves the moving of many different kinds of mountains.



STEEL: PARTNER IN ENGINEERING

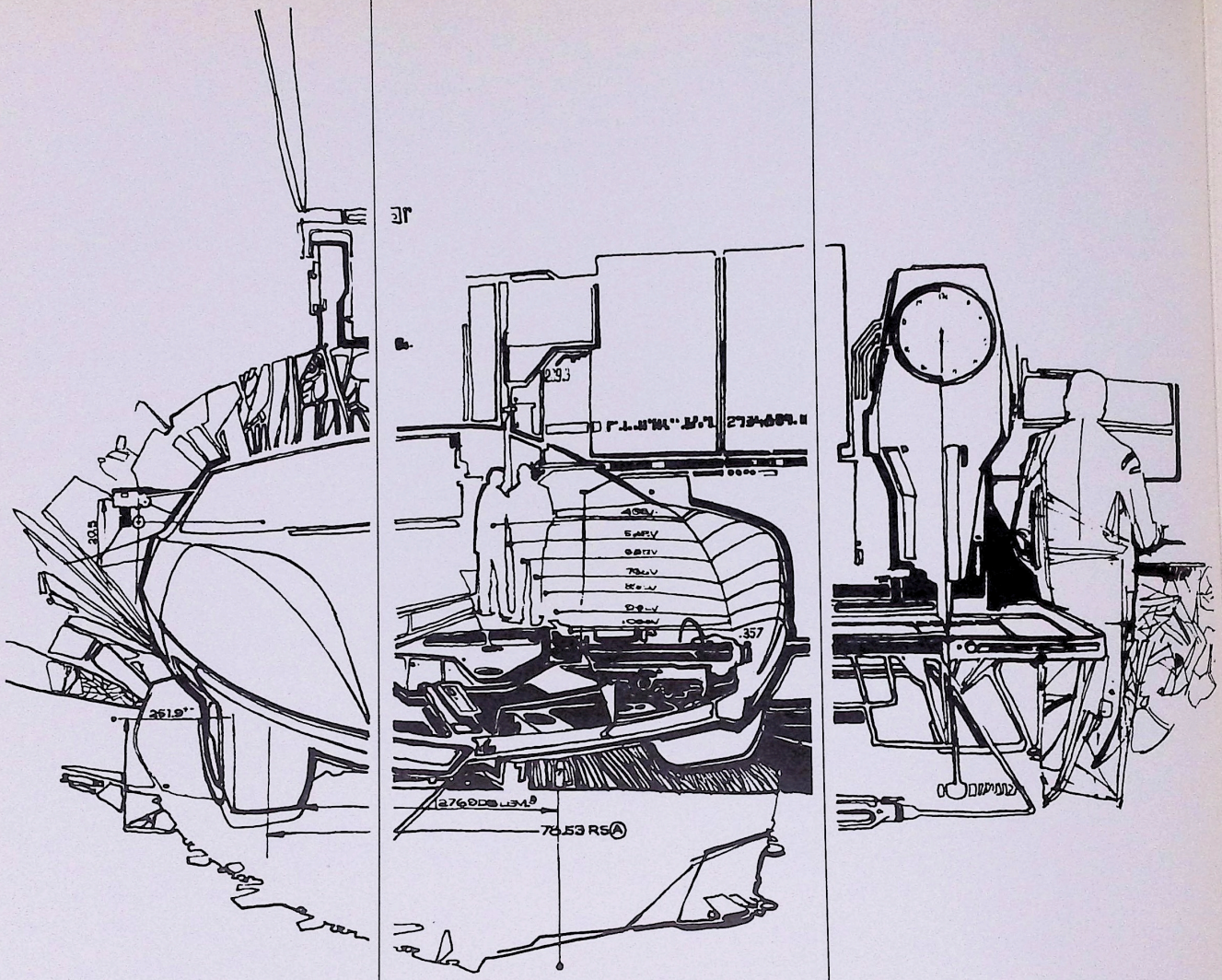
The automotive designer, putting ideas to paper, uses his knowledge of materials to create his forms and their functions. Constantly he *thinks* in steel, for steel has always been the basic material of automobile engineering and production.

But, more than this, the versatility of steel and the thousands of types and forms in which it is made available gives him design opportunities unmatched by any other material.

Engineers look to steel to solve the primary problems of strength, adaptability and economy. And, equally pertinent to today's design thinking, modern steel is depended upon to supply the designer's need for lightness, resistance to environment, and esthetic expression.

From the standpoint of technology, steel—the oldest automotive material—is also the newest. It is as new as the most recent metallurgical experiment at the USS Research Center at Monroeville, Pa. . . . as current as the pilot plant production of steel sheets coated by a new process . . . as contemporary as a USS engineer's recommendation of a particular steel to solve a specific problem.

As a partner in automotive engineering, United States Steel brings a family of steels to the conference table . . . steels by which the engineer can meet his ever tightening specifications, and solve his need for innovation.



STEEL SOLVES THE PRIMARY PROBLEMS OF STRENGTH, ADAPTABILITY AND ECONOMY

THE FAMILY OF STEELS

There is a *right* steel for every application. A steel which provides a combination of properties in the right balance for practical, cost conscious engineering. Theoretically, the right combination of steels, applied to the thousands of parts that require specific performance characteristics, could produce a vehicle in the spirit of the fabled one-horse shay—a conveyance wherein every part performed as well and lasted as long as every other part. And, collectively end their long terms of service in a classically synchronized count down. Nothing wasted, nothing wanting as in that famous one-horsepower vehicle.

Within the realm of practicality, the USS family of steels is designed and created to this specification ideal—the correct steel in the correct end use, and giving an optimum balance of properties to any assembly.

Carbon steel, first in the family, accounts for more than half of the vehicle by weight. Carbon steel offers great ductility and strength at low cost. Its excellent deep drawing qualities make it ideally suited to high speed production of cold-formed parts—to welding and coating. Sheets, bars, shapes, plates, wire—carbon steel offers the widest range of availabilities.

For many automotive applications, certain coated USS carbon steels can provide important end product advantages. Long Terne for example. This lead-tin alloy coated steel sheet handles reliability problems in gas tanks and air cleaners with outstanding economy.

Also in the classification of coated carbon sheets, USS produces a range of galvanized steels for a steadily increasing volume of automotive applications.

For the cold heading and cold extrusion of a wide variety of mechanical fasteners and other automotive parts, new USS Low-Carbon Martensitic Steels offer significant manufacturing-cost savings. Used as substitutes for medium carbon grades, they demonstrate excellent cold forming characteristics in the hot rolled (un-annealed) condition, and can be heat treated to surprisingly high strength and hardness levels, in some cases without the need for a tempering treatment after the quenching operation.

USS Alloy Steels for gears, bearings, springs, spindles and steering gear components are supplied in a series of types and grades to contribute the precise performance characteristics demanded by the end use. Among the 18 basic types, and nearly ten times that number of defined compositions, the designer can make precise selections for his demanding applications.

USS High-Strength Low-Alloy Steels offer definite combinations of properties for specific end results: strength, corrosion resistance, formability, ductility, weldability, abrasion resistance, plateability, and significant weight/strength price ratios.

1. EX-TEN high strength steel, with the best weight-to-cost ration. It enables the designer to trim weight, and generally costs, in critical areas without sacrifice of strength.
2. COR-TEN high strength steel, with great strength, outstanding resistance to atmospheric corrosion and exceptional paint life.
3. PAR-TEN high strength steel, with a combination of increased strength, surface quality, plateability and formability unmatched by other steels.
4. TRI-TEN high strength steel, which because of its balance of strength, toughness and weldability can introduce significant weight reduction and cost savings.

USS Stainless steels are a family in themselves. These brilliant, corrosion-resistant, heat-resistant and high-strength materials are produced in Austenitic, Ferritic and Martensitic types—in over twenty grades, and a variety of forms and finishes.

When engineering with the USS family of steels, solutions to problems come quicker. Less compromise with design is necessary. More opportunities to lower costs, decrease weight and speed production present themselves.

STEEL: PARTNER IN PRODUCTION

It takes many other materials to produce an automobile: glass, copper, brass, aluminum, lead, zinc, molybdenum, magnesium, silver, chrome, paper, chemical intermediates, elastomers, polymers, textiles and leather. Each material serves a purpose. Put-together they emphasize impressively the complexity and sophistication of today's vehicle.

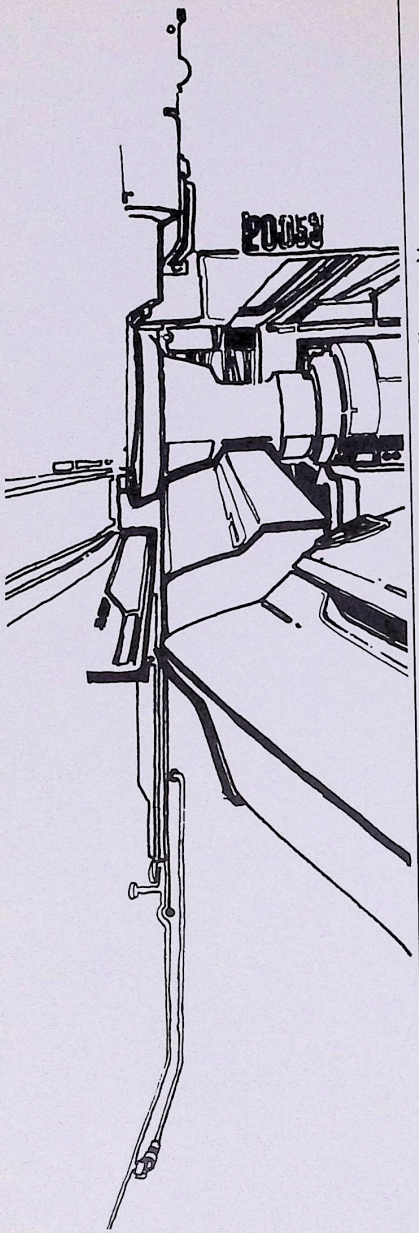
Yet, the role of steel, as the basic automotive material, is preeminent, accounting for about 65 percent of total weight. Just as long as vehicles need to be rugged, dependable and economical —just as long as their component assemblies must possess the twin properties of strength and precision—steel in its many types and forms will continue to supply the great majority of engineering and design solutions.

The techniques of steel fabrication: stamping, forging, cold-forming, welding, machining and rolling are familiar to the industry. When engineers switch to steel to make an improved part, production is no problem. New developments in the fabrication and use of steel are more often evolutionary than revolutionary, and thus are easier to adapt by production line personnel.

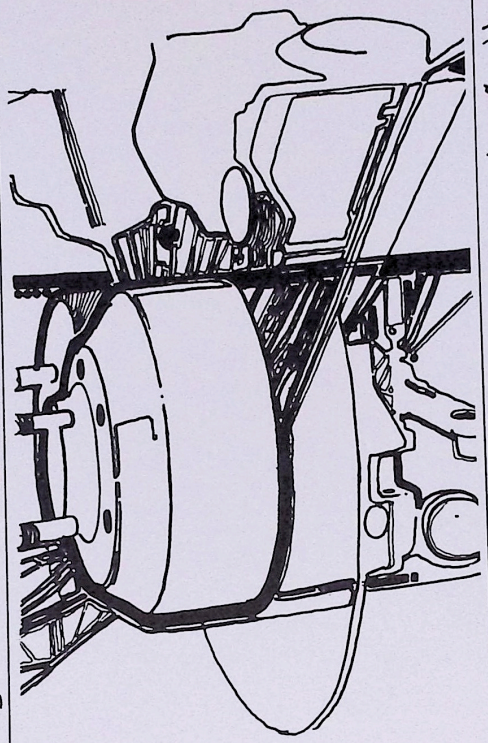
Keeping steel in its number one position as partner in production, means keeping it ever new—ever responsible to engineering innovation and advanced production techniques.

How can a materials' supplier serve in the role of partner in production? At United States Steel, we believe this means the direct involvement of all USS facilities in the constantly changing requirements of the automotive industry.

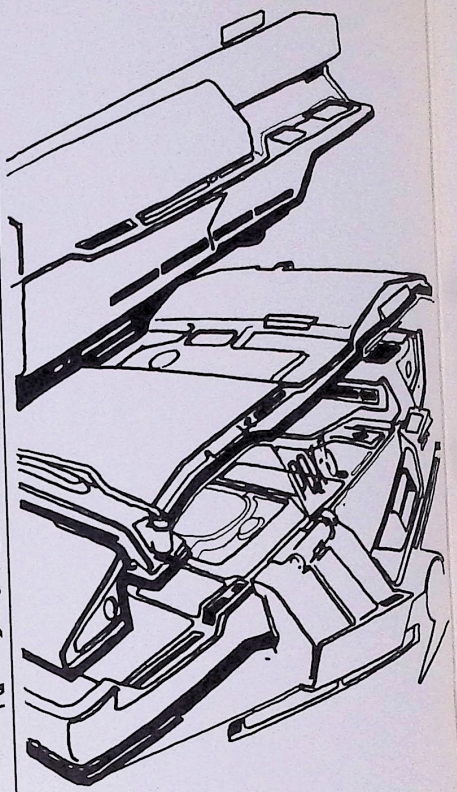
To achieve this, a comprehensive program of research, engineering and performance studies is maintained on a continuing basis. Some of the work is carried out independently. Much of it is done in collaboration with the engineering, design, production and procurement groups in the automotive companies. When a study results in a specific, economically sound innovation, it can save a manufacturer countless hours and dollars in development.



ROLLED FORMED BUMPERS



COLD FORMED WHEEL HUB



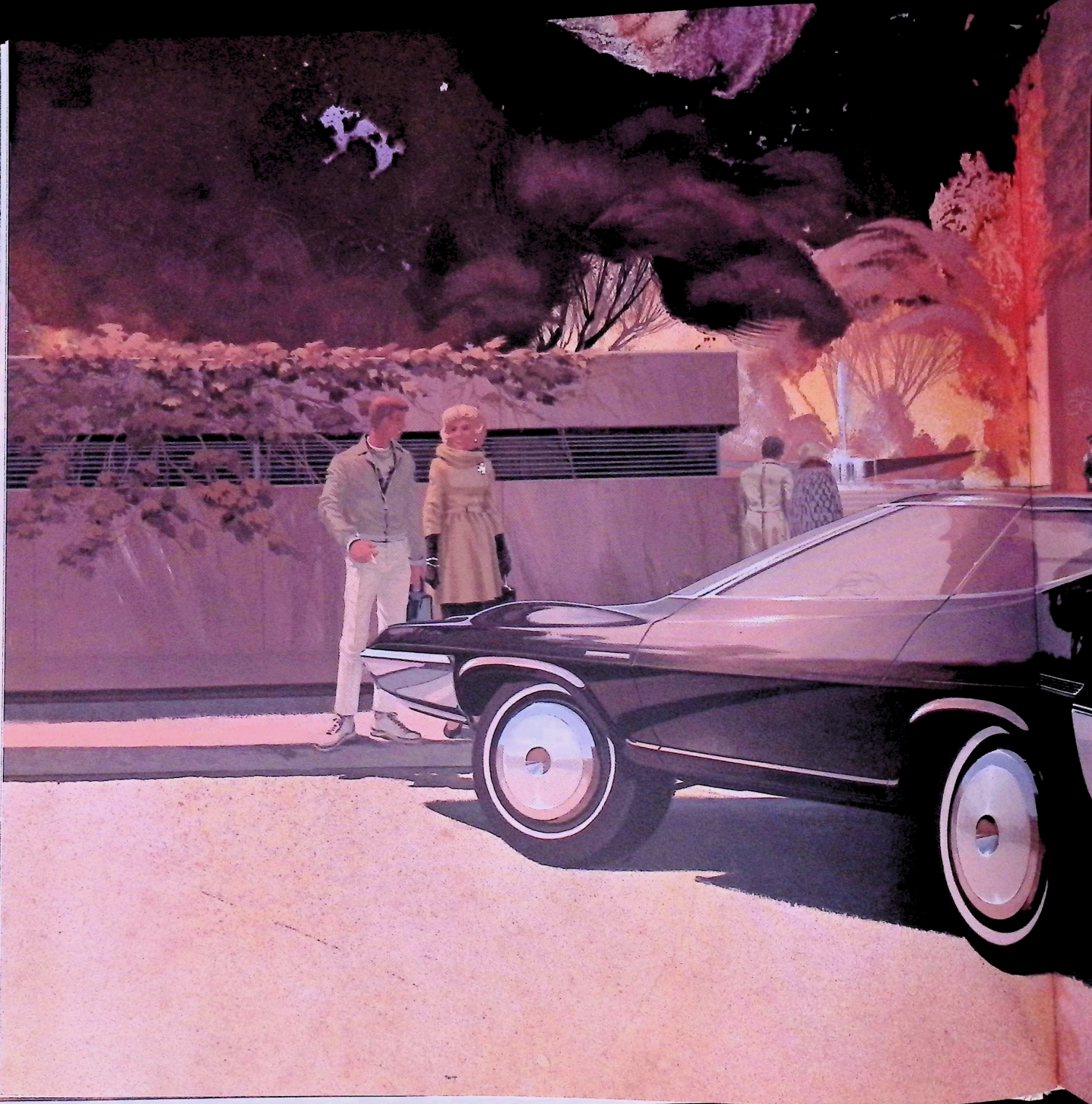
ADHESIVE BONDING

New methods for the cold forming of connecting rods, shift forks, wheel hubs and other parts of complex shape—from carbon and alloy steels—are under investigation in one USS study. Information obtained to date indicates the probability of a number of production benefits, including lowered costs.

Adhesive bonding of sheet metal panels as a replacement for usual welding and grinding techniques is being evaluated in another study. Key to the process is a new adhesive—developed by U. S. Steel. Known as USS NEXUS Thermoplastic Adhesive, it is suitable for high speed operations requiring instant bonding, attaining full strength by cooling to room temperature. This adhesive can be used to bond a variety of substrates. Good adherence may be obtained without elaborate surface preparation.

The composite roof panel is a concept of headliner design which appears to offer a number of advantages. Essentially, it envisions a one-piece, finished assembly unit—incorporating structure, insulation, and decorative finish. Constructed on a base of steel wire mesh, the composite panel eliminates a number of parts . . . reduces tooling operations . . . requires less parts storage space . . . and is installed in a single operation. The benefits of this design innovation include: cost reduction, gain in headroom and improved sound deadening.

Rolled Section Bumpers: U. S. Steel, who with USS PAR-TEN pioneered the use of High-Strength Low-Alloy steel for bumper applications, has underway development investigations for rolled section bumpers. High-Strength steels now provide over 50 percent of the requirement in bumper manufacture. USS PAR-TEN's superior surface and plating characteristics, plus its ductility are properties important to this end use. For the same end use in trucks or heavy duty, off-road equipment, USS EX-TEN steel can provide the required strength, ductility and paintability with economy.

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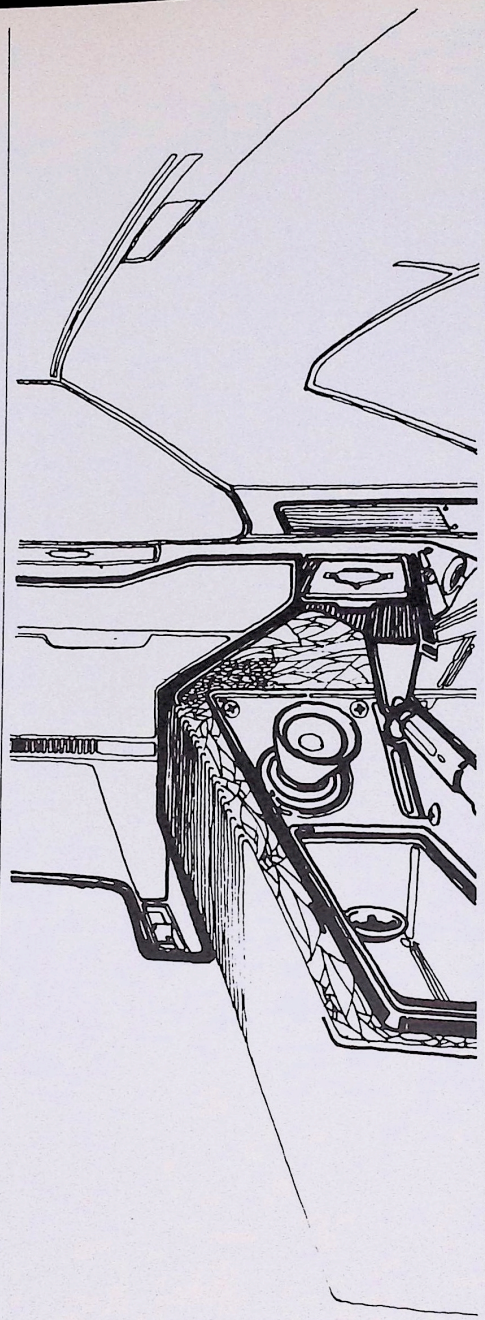
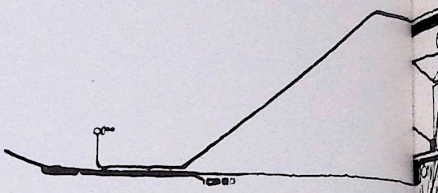
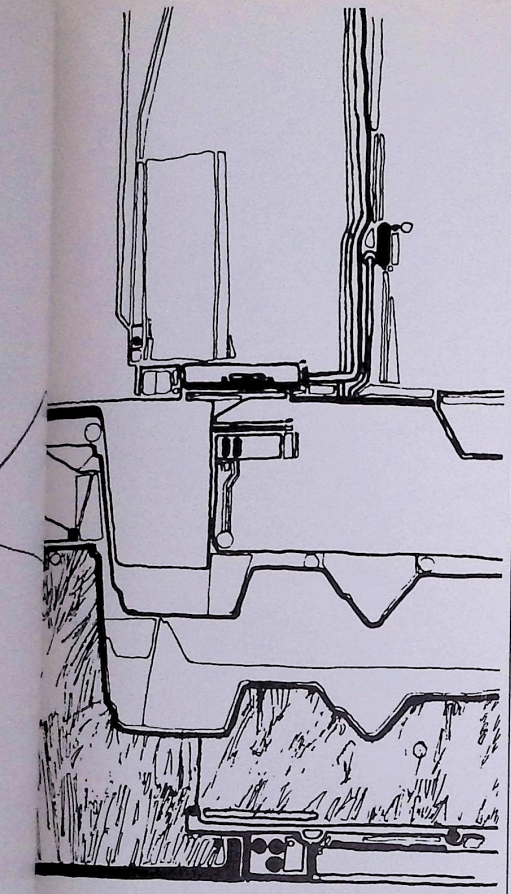






STEEL FIBER DIES

STEEL: PARTNER IN NEW MATERIALS

The development of a really new material is a rare thing.

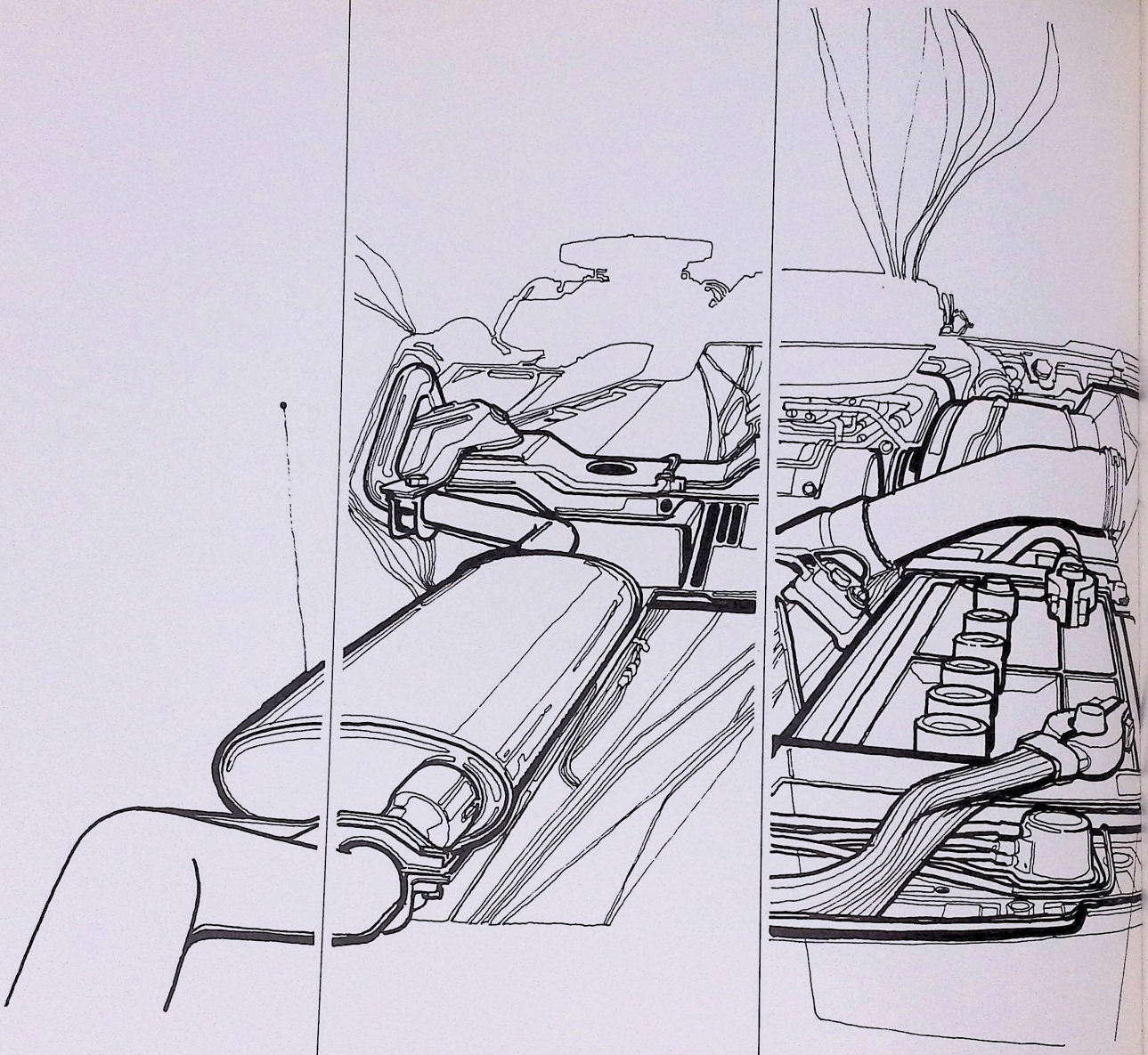
When it occurs, those who have had the experience know the many years it takes to perfect the new discovery . . . prove it out . . . develop standards for properties and performance.

And only the producer of such a material can do these things, for those who might be able to use the product can only be concerned with their own particular needs and the relentless timetable of their own production. It is the responsibility of the producer to instigate a program of applications research to make the new material fit engineering and production requirements.

USS Design Study Program #6022 involves the development of steel foil and its potential as a material for heat exchange applications. This material, relatively new to the automotive industry, holds out the twin promises of high efficiency and economy.

As most good ideas are, the design is quite simple: die cut sheets of steel foil blanked from a coil . . . edge welded and then stretch-expanded much in the same manner as the paper festooning hung from the chandeliers for gala occasions. The advantages: an enormous surface area for cooling . . . light weight . . . design freedom . . . economical. Its applications are many: engine radiators, air conditioning evaporators, transmission fluid and oil cooling; in fact, any heat exchange problem is a target for this new material.

Another USS program begun two years ago has been expanded far beyond the original objectives. It proposes the incorporation of steel fibers in moldable plastic materials to produce hard surfaced, low cost dies and metal stamping forms, as well as finished hardware and other molded parts. The steel fibers (up to ⅛ inch in length) contribute the reinforcing strength, and act to dissipate heat quickly.



USS 100 STAINLESS STEEL MUFFLER AND TAILPIPE

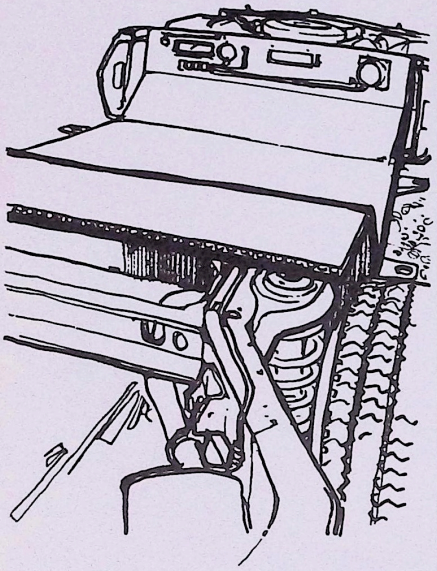
STEEL REINFORCED BATTERY CASE

Currently, three types of steel fiber-plastic material combinations are being evaluated: steel fiber and urethane elastomer for wear resistance, steel fiber and epoxy resin for molded components, and steel fiber and glass resin for high temperature applications.

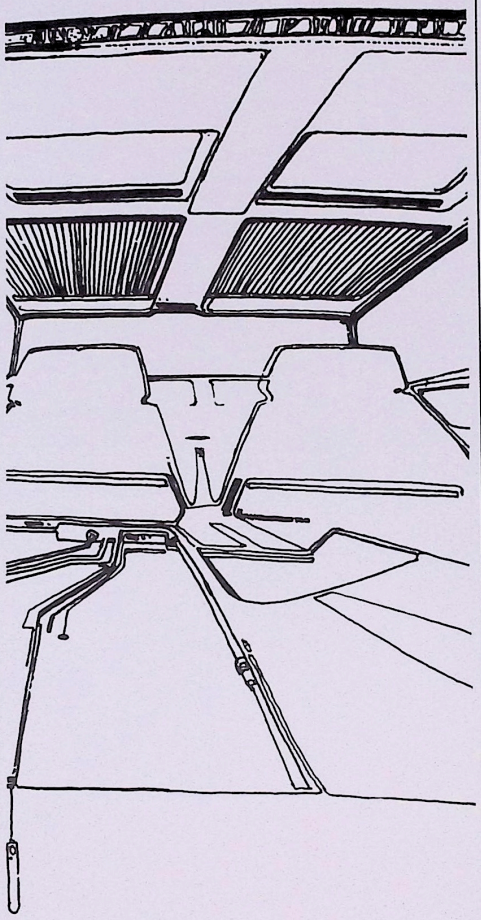
Techniques of die making are part of this study. One of these allows for the advance setting up of the steel fibers, in a lattice-like structure, prior to adding the plastic compound. This is accomplished in a vacuum chamber, and results in an even dispersion of the steel fibers throughout the mold—eliminating soft spots, and insuring improved dimensional accuracy in the cured die.

Often the search for new materials uncovers a new use for a long familiar one. Tinplate is an example. Its gleaming finish and fine resistance to rust and corrosion are twin arguments for its use in ash receivers, glove compartments and lighting reflectors. With a melting point high enough to resist marring by a crushed out cigarette, tinplate should prove to be an economical way to give more appeal to those interior appointments that are too often discounted as contributors to market appeal.

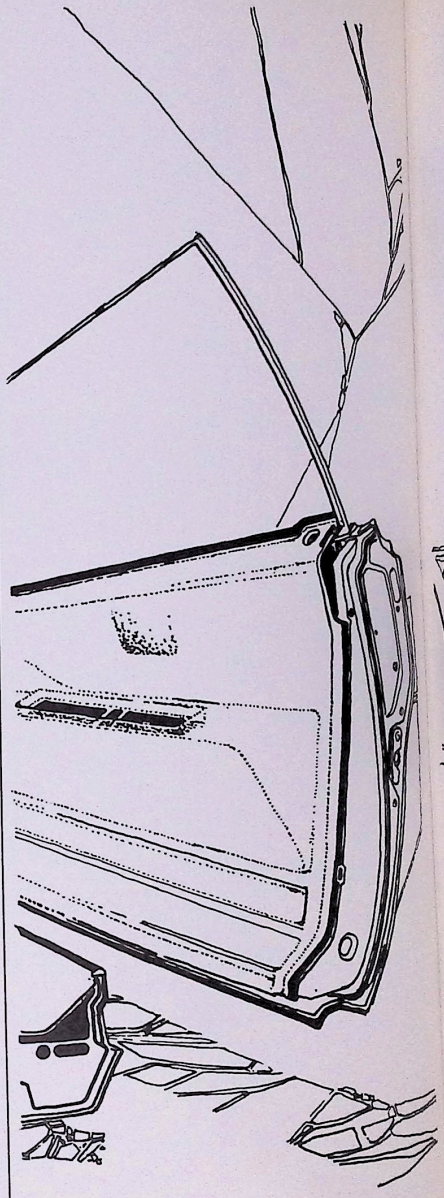
United States Steel, with 10,000 types and forms of steel at the service of the automotive industry, is constantly working on new developments—always with the objective of keeping steel contemporary.



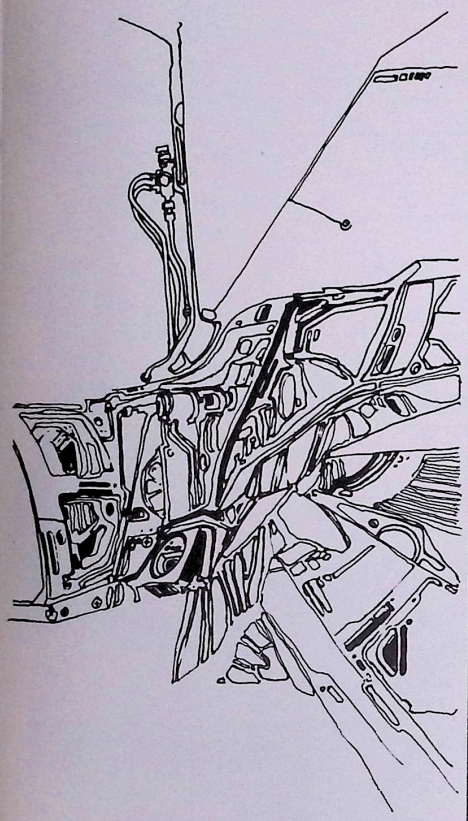
SANDWICH PANEL



COMPOSITE ROOF PANEL



WIRE MESH INNER DOOR PANEL



PARTNER IN NEW COMBINATIONS

As part of its materials engineering and applications development research, United States Steel is continually engaged in evaluating the potential of new combinations of materials.

Many USS Design Study Programs are dedicated to this concept of making the best utilization of two or more known materials . . . synergism in a real sense, where the result is far greater than the sum of its parts. Such combinations, by incorporating the properties of one material with those of another, can result in a new material capable of stimulating original concepts in automotive engineering, and giving new directions to design thinking.

In these studies, all materials—both organic and inorganic—are reviewed, analyzed and tested. Generally, the contributions that steel makes to the partnership are strength and ease of fabrication. Other materials are counted on to supply such qualities as color, tactility, resistance to environment and bondability. Both play a part in the all important esthetics.

In a development typical of this partnership principle, the spectacular bonding characteristics of epoxy adhesives—cross linked resins that cure themselves by irreversible chemical change—provided the impetus for the development of a really new steel product. Called a Sandwich Panel, it is a honeycomb of steel bonded between two steel sheets.

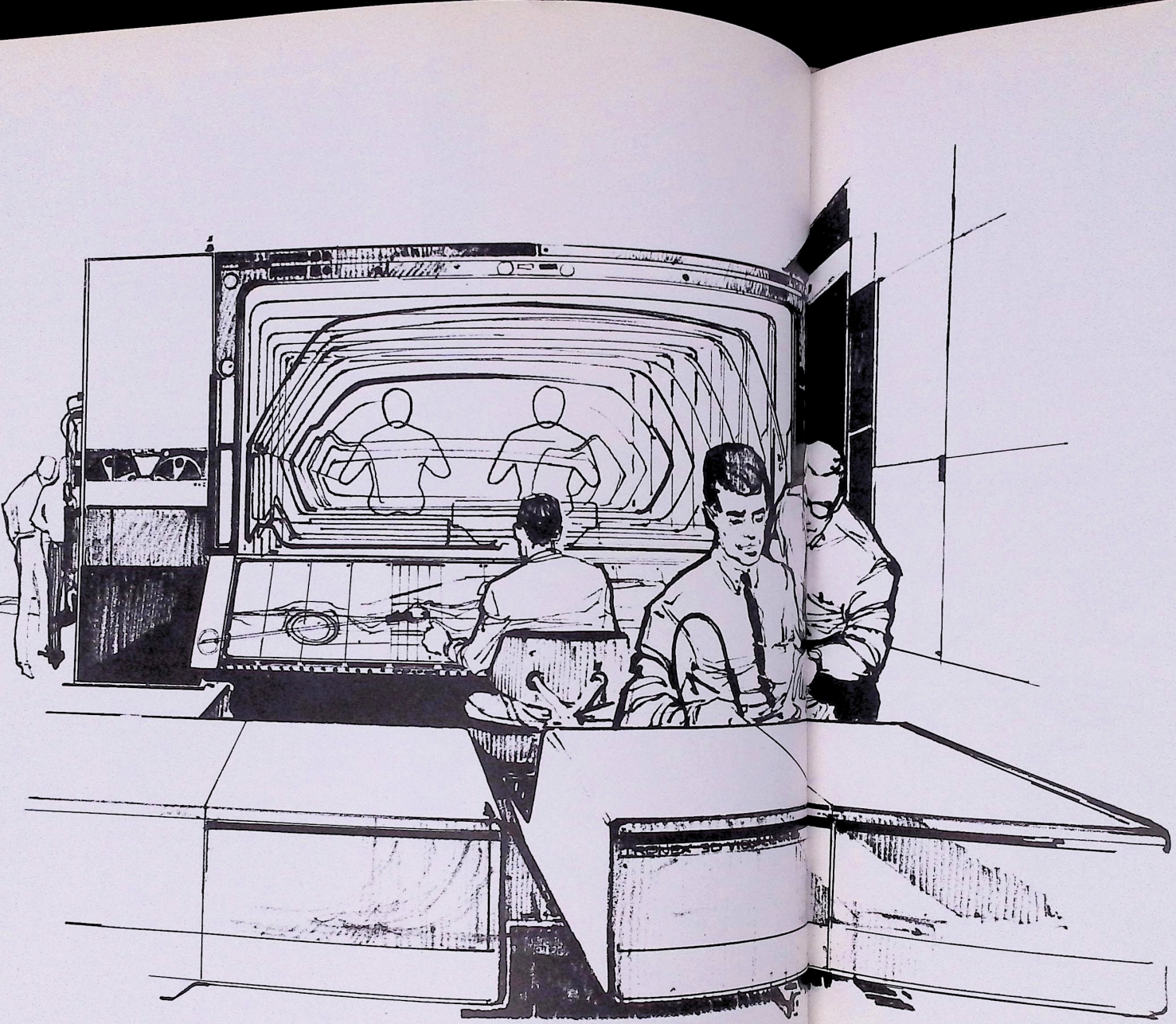
The sandwich panel is light and strong. It has the beam strength of ¼ inch steel plate and the weight of ¼ inch aluminum plate! In vehicle construction, it can provide a floor, save weight in structurals, and, quite as important to design, save critical space in the package.

Another current Design Study Program concerns a highly functional, decorative and economical inner door panel combining steel wire mesh, insulation and soft finish. This combination should possess the required structure, permit great flexibility in the use of styling maerials, and have applications in other parts of the package.

Other new combination concepts covered elsewhere in this volume include:

Adhesive Bonded Door Panels
Steel Fiber-Plastic Dies
Composite Headliners

To the automotive industry, material combinations offer the exciting promise of reducing costs, improving performance, and opening up design opportunities. At United States Steel, the development and practical application of multi-material products is a prime objective of many of its Design Study Programs.



THE PACKAGE

EYE OF THE HURRICANE

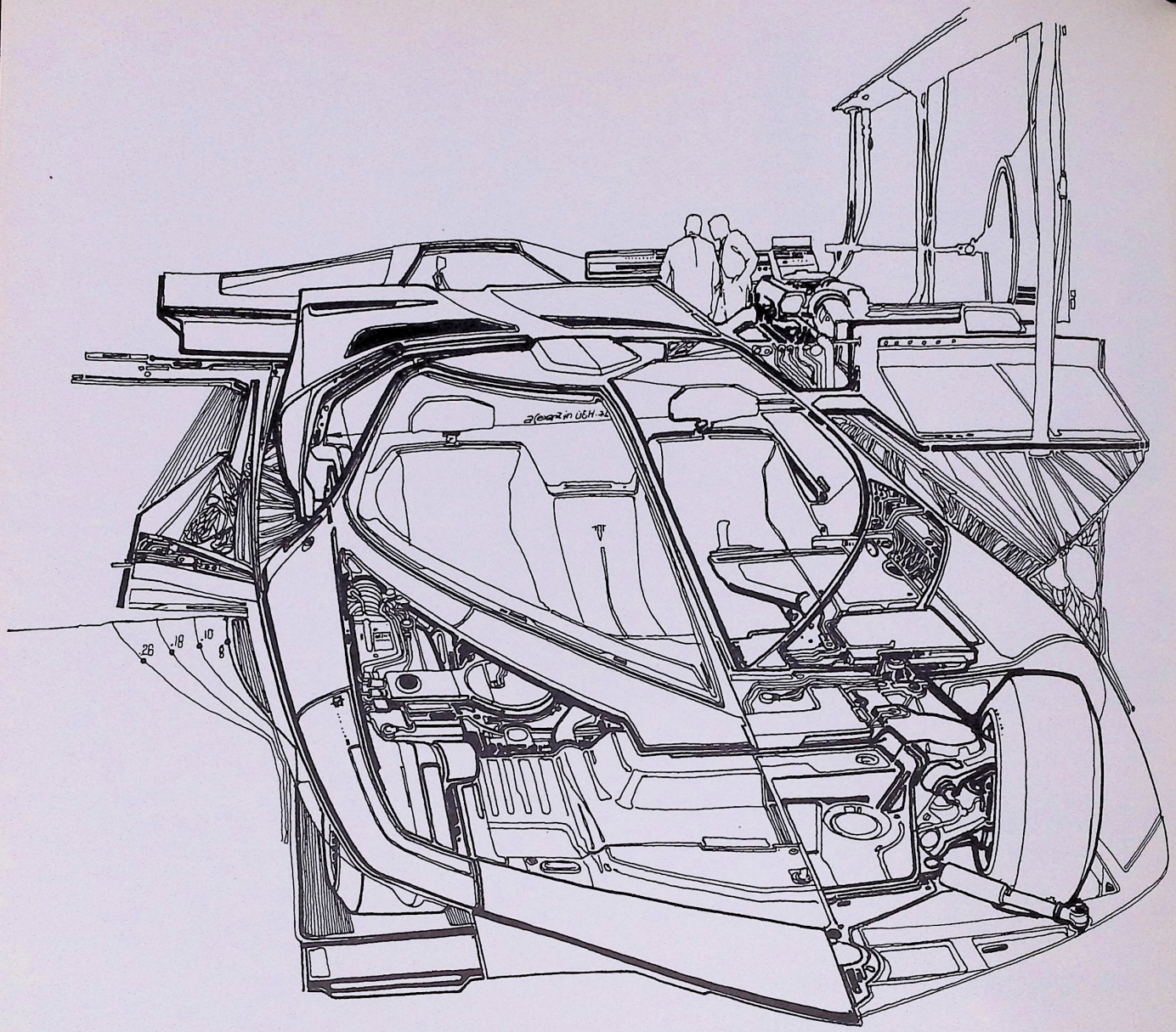
The modern vehicle is an expression of movement in three parts. Its power plant, traction and package are a unity of organic design.

At average turnpike speed, it covers 88 feet in a second. Each wheel turns twelve times in that second. The tire tread in contact with the road is stationary, while its opposing side is traveling 176 feet per second. The engine turns 4,000 revolutions per minute, and each piston reverses its motion 8,000 times.

Because the vehicle continually preempts the space occupied by the atmosphere, it travels along in a turbulence of its own making.

Given these conditions, it is the designer's assignment to create accommodation for driver and passengers—a package as tranquil as technology can fashion. An eye in a hurricane of kinetics.

A mix of factors impinges on every engineering decision: visibility, vibration, sound, balance, temperature, and an indefinable sixth factor which probably is a combination of all senses as they relate to man in motion under his own control.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THE VEHICLE: CIRCA 1970

Like a man walking into the wind, the automotive industry must assume a slant posture to insure its successful progress. Today's business and profits measure its current health, but forward-looking research and development constitute the touchstone of success tomorrow.

For the engineering and design groups, leaning into the wind means working with a calendar two to five years advanced. And—dead reckoning—determine consumer tastes and prejudices long before they crystalize in the public mind.

What are the specifications of the vehicle of 1970? What is the package? What is the styling that will catch the consumer's eye, elevate his blood pressure and lower his sales resistance? As suppliers of the basic automotive material, United States Steel searches for answers to these questions as the first step in providing a comprehensive materials service to the industry.

Certain facts seem to us to loom large in importance, and USS research has them ticketed for special attention and emphasis:

Lower costs • Greater emphasis on safety • Reduction of non-working weight • Driver and passenger comfort • Improved vehicle performance and efficiency.

In every one of the above areas, USS has numerous DESIGN STUDY PROGRAMS and laboratory investigations. Some of these are innovated by USS as part of its long range study of trends and developments. Many have resulted from direct industry requests for solutions to specific design and engineering problems. USS welcomes suggestions and direction from those who are involved in the engineering and design of tomorrow's vehicle.

THROUGH THE LOOKING GLASS

The vehicle of the seventies . . . how will it compare with the car of today? U. S. Steel has no magic device through which to peer into the future. However, this much is certain: the vehicle of tomorrow will be engineered with greater sophistication and complexity. Because of this, our responsibility as a materials' supplier is sure to increase.

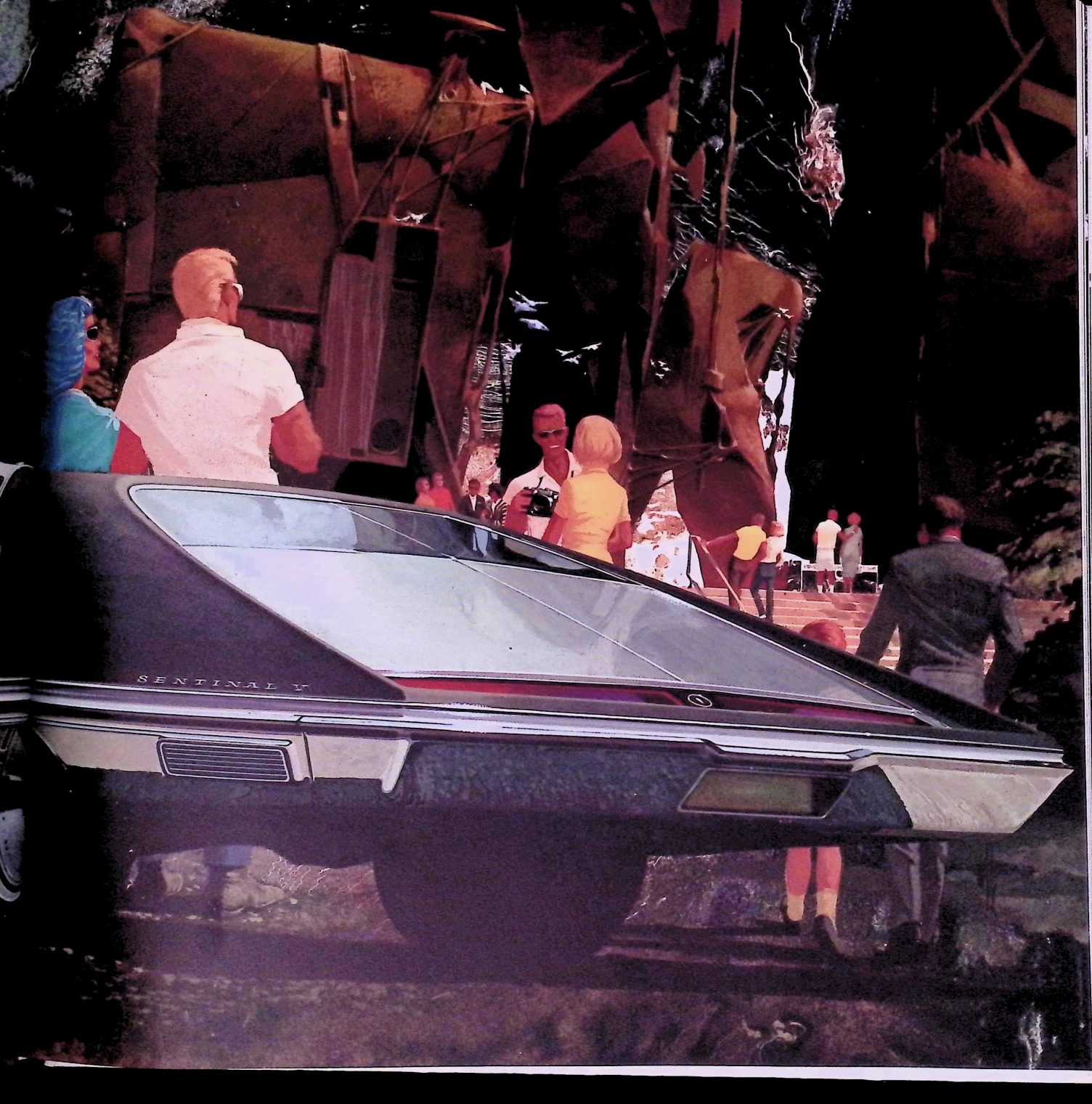
Research and development in materials are essential contributions to good automotive engineering, and the materials' supplier, to properly serve the industry, is depended upon for a full complement of technology in properties, fabrication, production and value engineering.

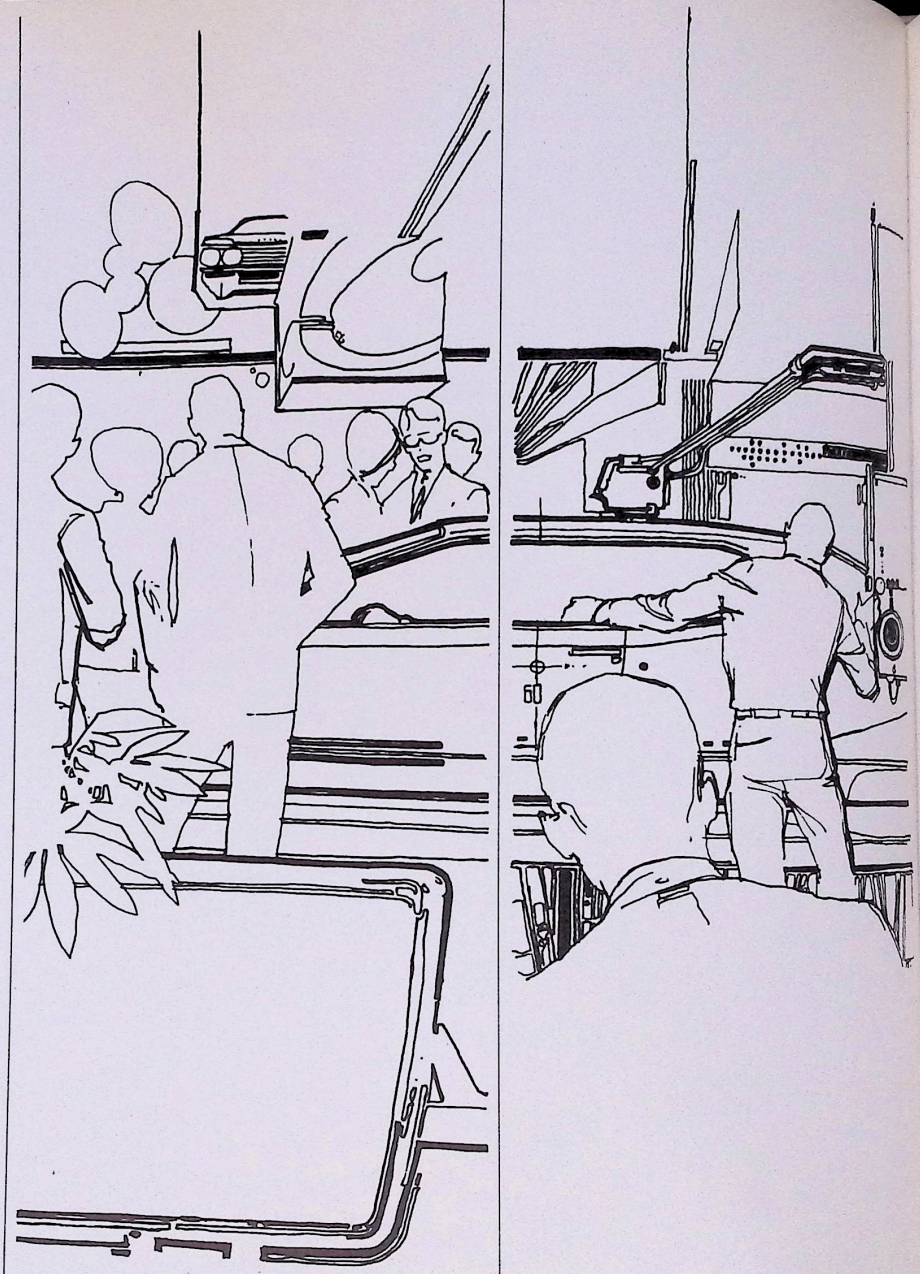
That's why looking ahead is an essential assignment of U. S. Steel research services to the automotive industry, and the motivation behind this series of visual interpretations of:

Luxury Sedan • Sports Car • Station Wagon • All-Purpose Cargo Vehicle • Racing Car.

It is hoped they will serve as reference points for the many innovations in materials, combinations, forms, assemblies, accessories and such that originate in USS laboratories and plants.


GRAND
MARINA


SENTINAL V



WHAT MAKES THE COVETED BEST SELLER?

MARKET APPEAL

THE DECISION TO BUY

This year, 10 million consumer decisions to buy will present a bill of financial health to the automotive industry. The motivating factor behind these decisions is the nearly undefinable thing called *market appeal*—the factor of automotive marketing most analyzed, most documented, and probably most obscure.

What makes the coveted best seller?

People are not alike, nor are their preferences necessarily similar. Every year, it would seem as though the car buyer gains in individuality and independence. Yet, in spite of the great diversity in public tastes, when it comes to the personal vehicle, one man's meat still is apt to be the majority's diet.

For the designing teams, it is already 1970—and later. The market appeal that is put on paper and prototyped today must be based on consumer opinions that are not yet formed, and won't be expressed for several years.

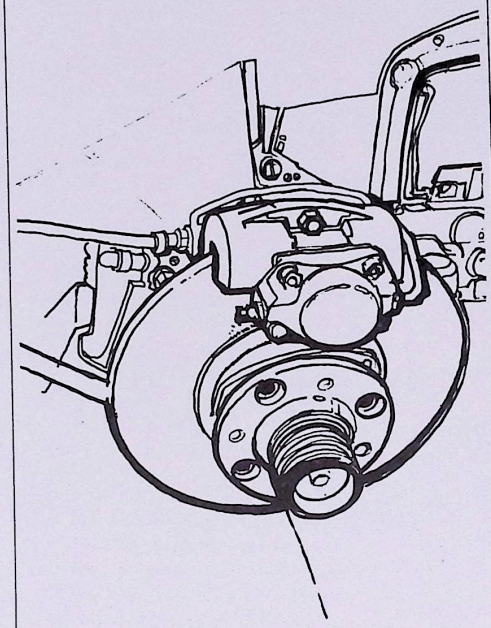
Research at U. S. Steel shares with the automotive industry this responsibility of looking into the future. By this approach we believe as suppliers of the number one automotive material that we can serve the industry more effectively.

What are the prime ingredients in the recipe for tomorrow's market appeal?

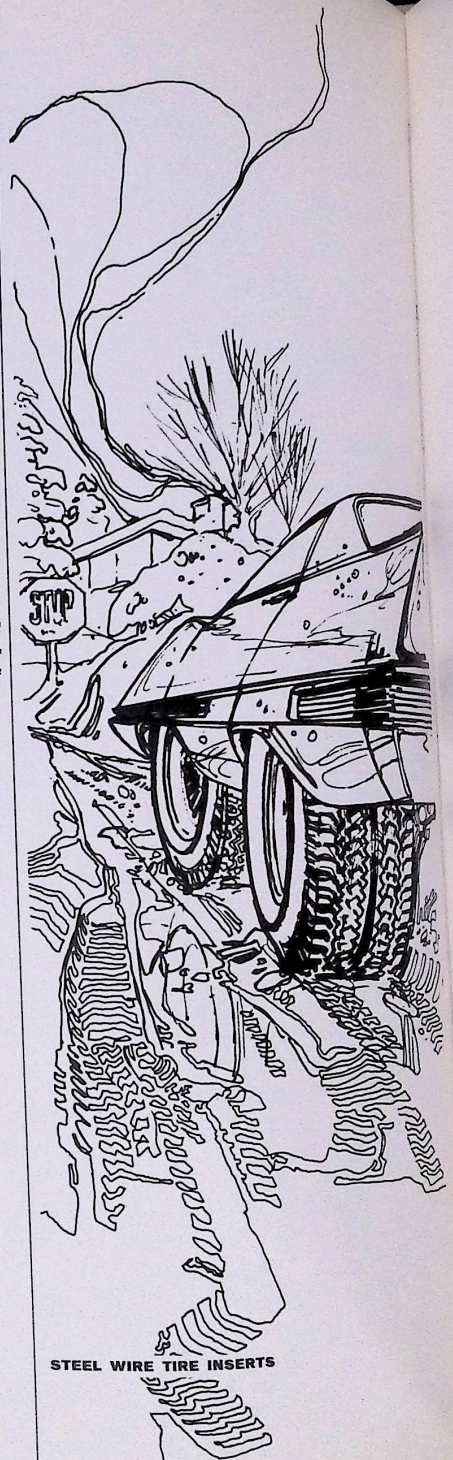
Just as the black painted strip along the Bonneville Salt Flats sets the course for the driver in the cockpit, there seem to be certain reference points worth consideration when we try to anticipate the market-appealing vehicle of the '70's.

1. An aerodynamic profile in harmony with the invitation of the nation's lengthening network of super highways.
2. A power plant and transmission to match.
3. A package designed for greater distances—accenting accommodation, relaxing comfort and driveability.
4. Frank emphasis on safety.

In the search for market appeal, the capabilities of steel for innovation and economy can make an impressive contribution. Steel more than any other material can give the designer and stylist the freedom they need.



DISC BRAKE CALIPER



STEEL WIRE TIRE INSERTS

PARTNER IN SAFETY

It is said that man drives as he lives. If this is so, and there doesn't seem to be much evidence to the contrary, the task facing the industry in building a safer vehicle is not made any easier—nor less urgent.

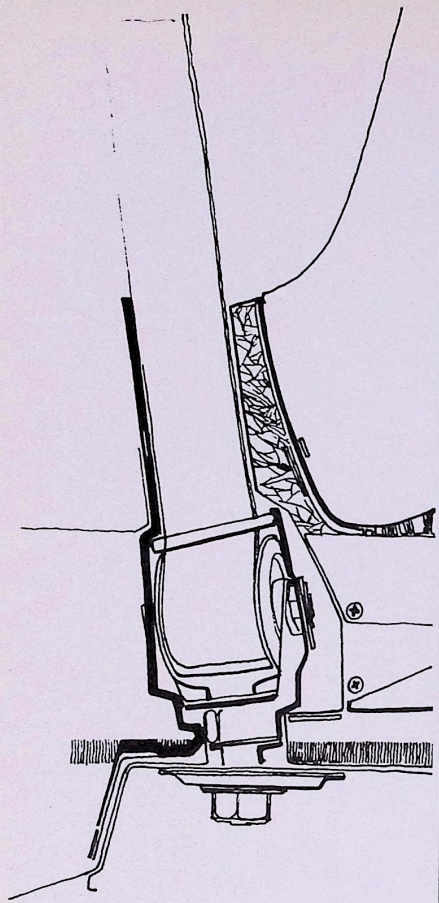
Nearly a hundred million licensed drivers . . . nearly a hundred million different attitudes to take into account, when the thousands of parts that constitute the modern automobile are assembled.

Within the automotive industry, safety has always been a constant specification—written into every design, package and part. The proof of this is not hard to locate. It is shown in the statistics of the accident rate per miles travelled—a figure that has been dropping steadily since 1915, while speeds have just as steadily increased. Nevertheless, the problem of driving safety is certainly still with us. We cannot make it vanish by looking backward at reassuring statistics.

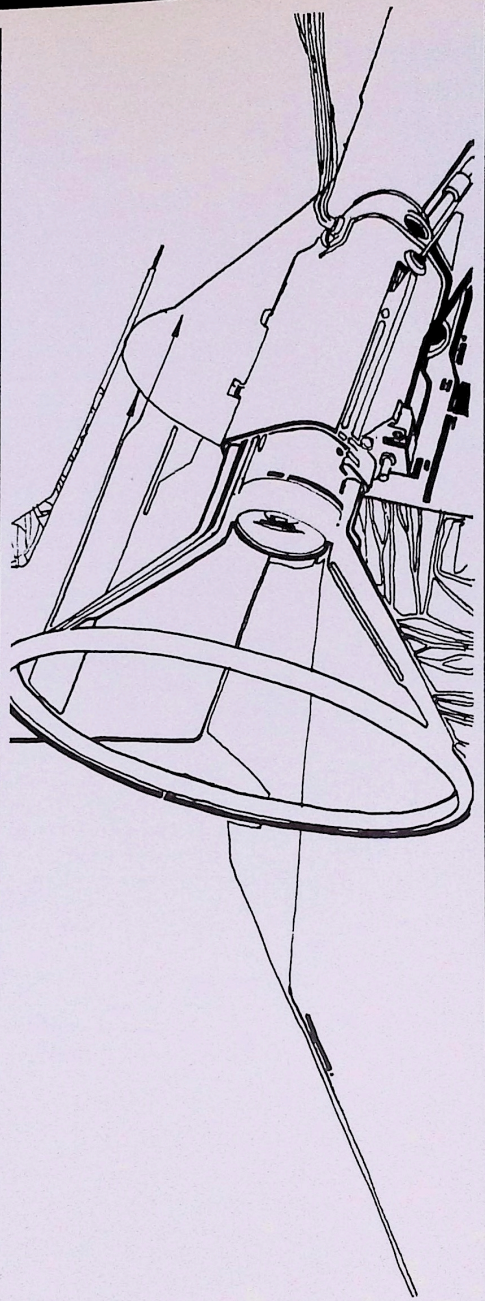
Like a safer driver, a safer vehicle is a blend of balanced judgment. It is a combination of careful engineering, correct instrumentation, designed-in driver comfort and visibility. And, as always, dependability of materials.

The safer vehicle must have grace and spirit—market appeal. Unless it does, it will lose its power to persuade, and its contribution will add up to zero. This simple truth is fast being realized by governmental groups and by all vitally interested organizations outside the industry; the industry itself has always been aware of it.

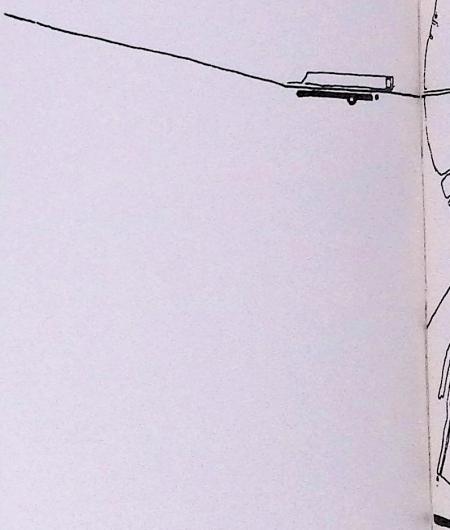
Current developments in automotive design are proving that a successfully safer vehicle can still retain the styling so important to consumer acceptance. Its impact resistance, engineered from the inside out, should embody an optimum mix of rigidity, energy absorbing yield, and crumple characteristics—able to dissipate the kinetic energy of momentum in a three-stage, planned progression of events. The strength of framing . . . the attachment of the power plant . . . the architecture and bolstering of the package are concomitant factors in this effort to reduce by precious percent-



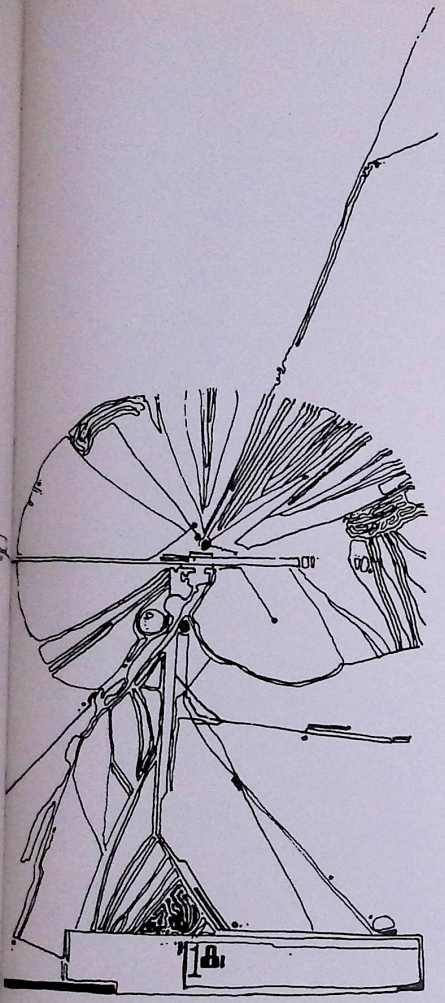
SEAT BELT ANCHORS



COLLAPSIBLE STEERING COLUMN



ELECTRONIC ASSIST



age points the human toll of collisions.

To engineer against the effect of collision, the USS family of steels is there for the designer to draw on. Alloy steels can be used with economy to put impact strength where needed, and without adding weight. In other parts, they can be used to achieve optimum balance between rigidity and yield. And carbon steel sheet can be depended on to contribute the all important energy dissipating characteristics. Much USS engineering innovation research is going into this important and sensitive subject. For example:

An impact-yielding instrument panel, housing instrumentation in breakaway recesses, and produceable well within cost limitations . . . wire reinforced dust shields and wagon safety curtains to bar luggage and equipment from entering the passenger area . . . a fail-safe or collapsible steering column of efficient design . . . a frangible steel sun visor with a "soft touch" mounting, and photochemically etched for safer, partial visibility when it is down in operating position . . . steel web seat belts and stronger alloy steel buckles and attachments.

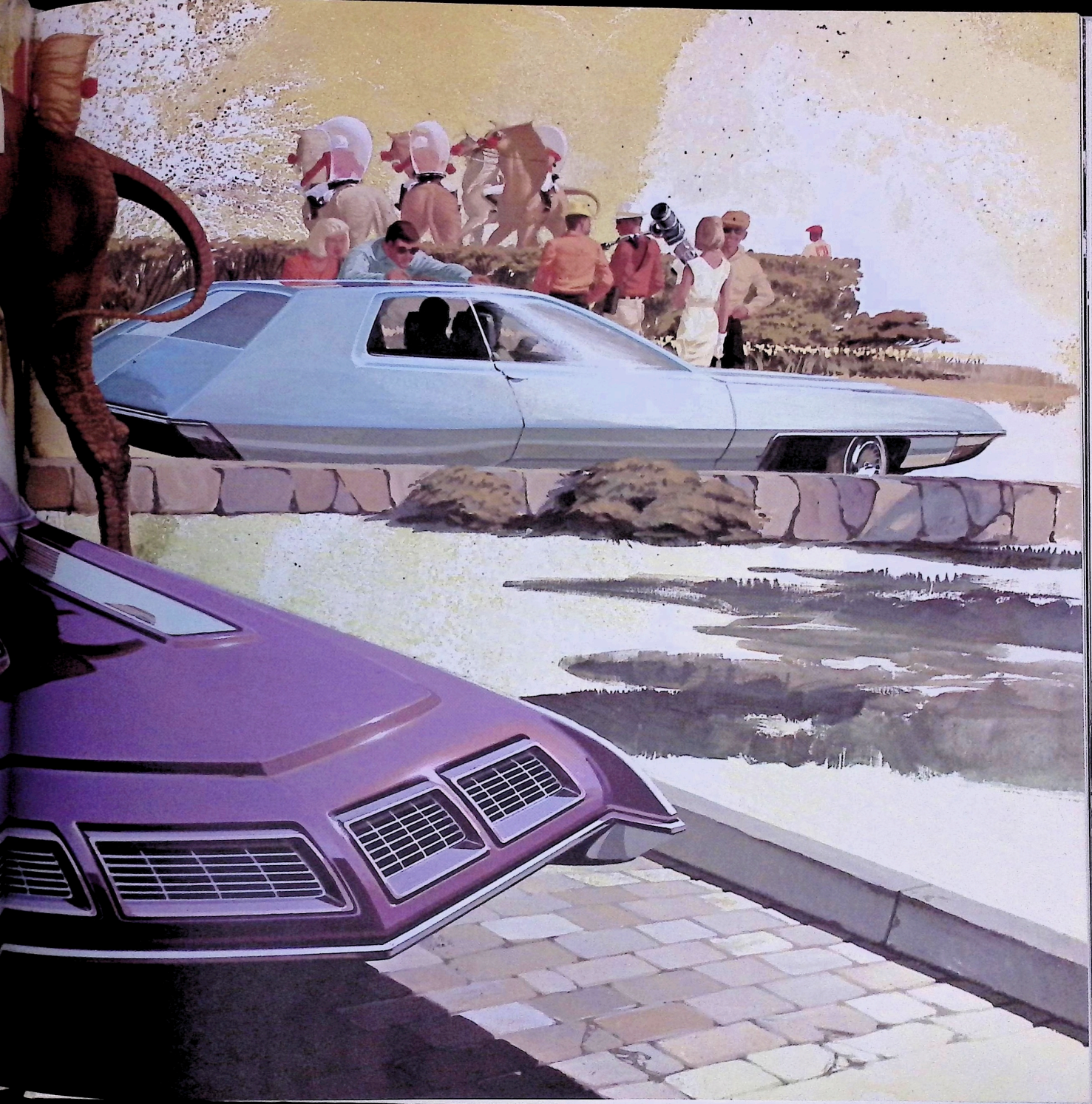
But perhaps the most significant contribution the automotive industry can make toward safety lies in the engineering of the vehicle to *avoid* accidents—not just to reduce their severity.

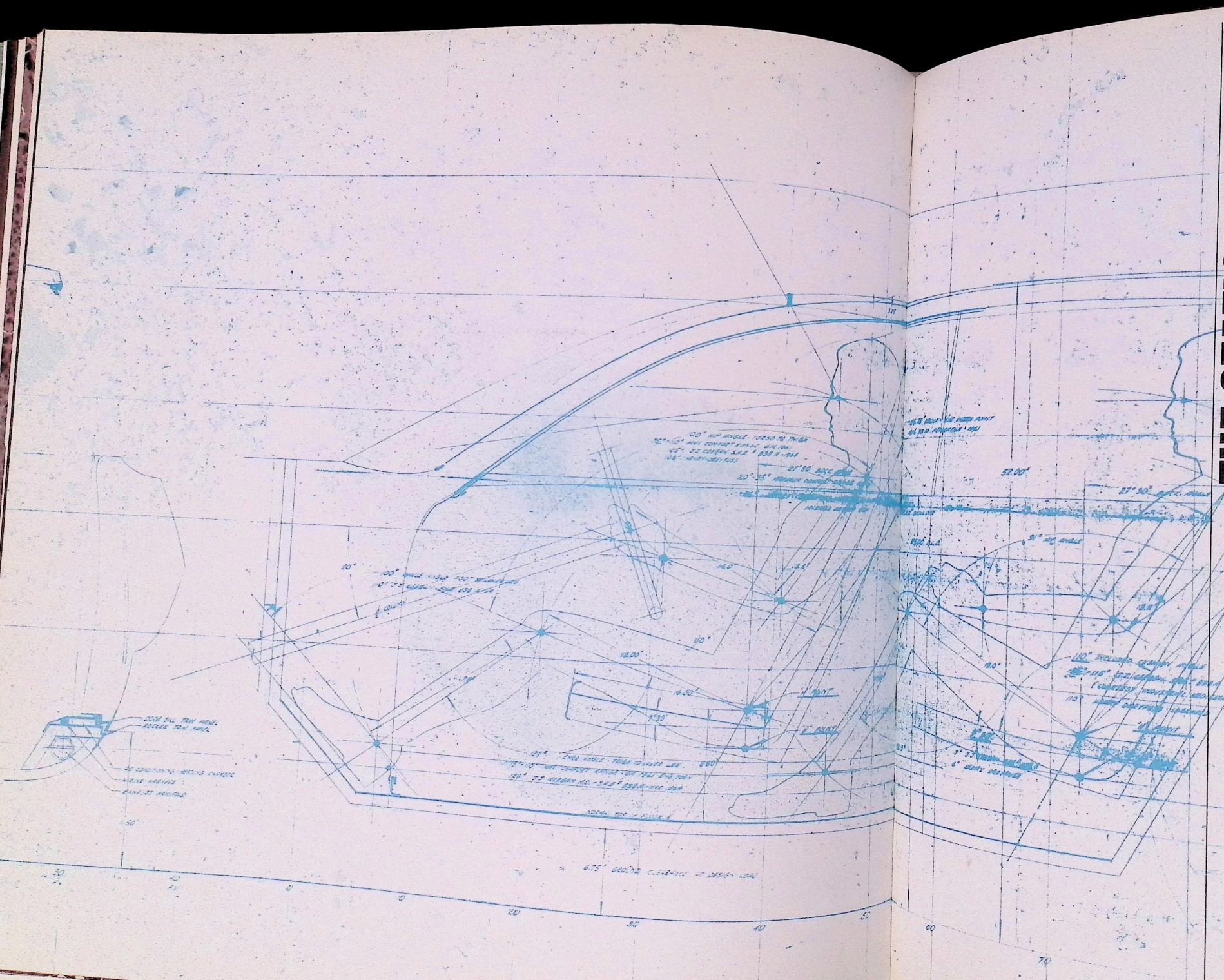
A comfortable driver is a relaxed driver —more apt to make quick and correct decisions. A quiet package, insulated from vibration and noise . . . climate controlled . . . seating that conforms to his body structure . . . instrumentation that communicates information clearly —these are the areas of opportunity most promising in the search for safety.

Many USS Design Study Programs directly and indirectly relate to the engineering problems involved in the construction of a safer vehicle. For example:

Seating studies wherein steel wire is employed to posture-contour the seat to accommodate the wide range of human frame sizes and proportions . . . sandwich panel construction to stiffen the package and remove excess weight . . . hydraulic accumulators for "no travel" brake and accelerator systems . . . tire tread incorporating steel wire inserts . . . cold forming of parts from low-carbon martensitic steels—energy absorbing steel structures to provide controlled deceleration.

As a principal supplier to the automotive industry, United States Steel has given high priority to these studies in safety. Progress made to date plus collected data are available to automotive designers as a means to speed their own investigations.





THE STATION WAGON

The love affair between people and the automobile is a phenomenon of our time.

Perhaps because they grew up together, man and machine have created a new way of existence on this planet—expanding the individual's work area capabilities to hundreds of square miles in size, and turning the continent into a playground. The romance is permanent now, and its result is a new concept of power and movement—with transportation, industry, education and pleasure becoming a composite assignment of the modern automobile.

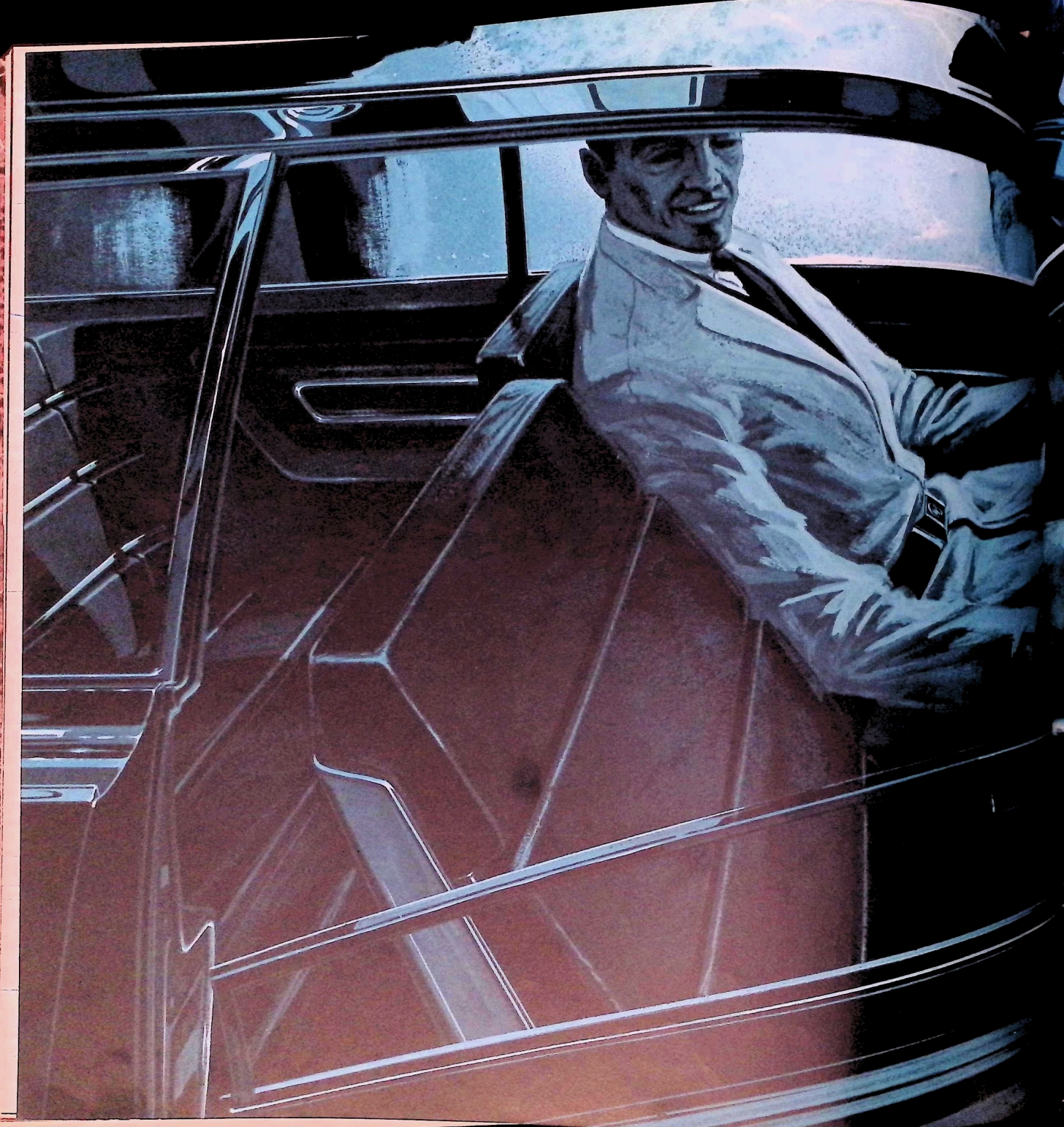
The station wagon is an eloquent expression of this diversity of services. There is something in it for everyone. And it takes readily to innovation.

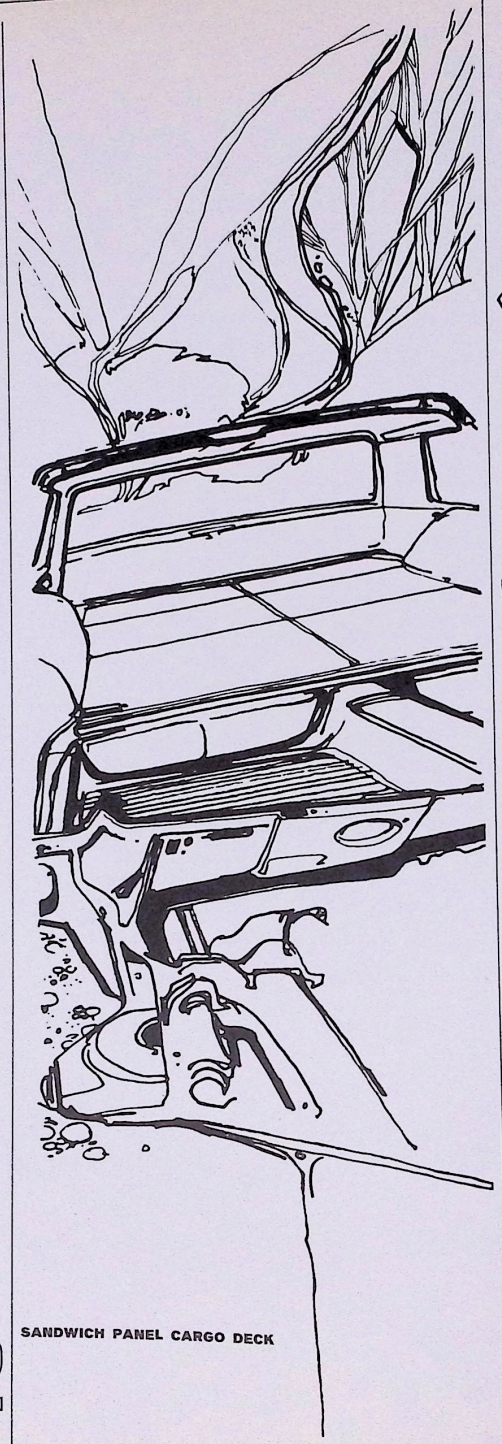
The USS station wagon was designed and built to demonstrate the automotive orientation of United States Steel and to coordinate many separate Design Study Projects relating to vehicle structuring and styling. Implicit in its engineering is the fact of making steel perform a multi-function wherever it is introduced—improving strength-to-weight ratios . . . increasing interior room . . . creating manufacturing economies.

The underbody is of sandwich panel construction. This gives improved entrance and exit characteristics, with road clearance unaffected. There is a significant increase in structural efficiency, with greatly improved resistance to racking distortion.

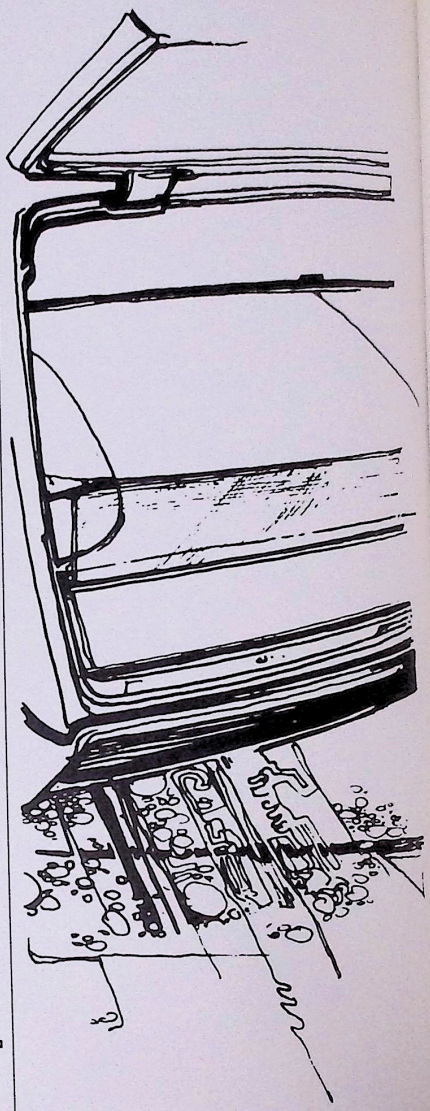
Composite roof panel structure welded to side rails results in an overall height reduction to 51 inches, while retaining a package equivalent to that of a vehicle 55 inches high. Four passengers are accommodated in virtual chair height comfort.

The exterior belies the wagon's utilitarian destiny. Looking more like a fastback sedan than an all-purpose family retainer, it does indeed suggest that surrender to styling innovation need not mean a sacrifice of capacity nor the loss of important wagon functions.





SANDWICH PANEL CARGO DECK



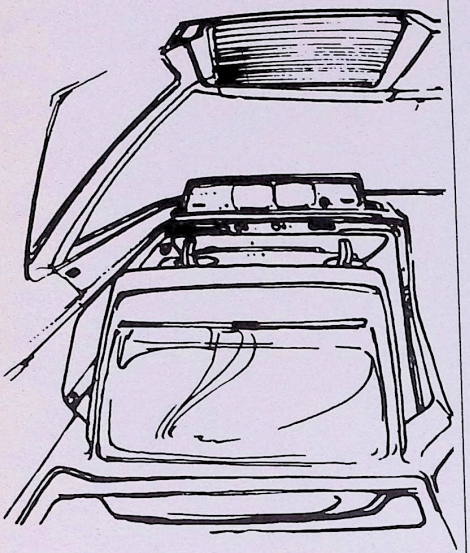
STEEL MESH SAFETY CURTAIN

The engine hood features left and right recessed panels which serve as air intakes for carburetion and air control systems. The hood panel and stiffener are adhesive bonded together to create an air intake duct. Headlight and taillight grilles are of steel-fiber construction—compression molded and chrome plated. The roof is brushed stainless steel. Wheel covers are formed stainless steel.

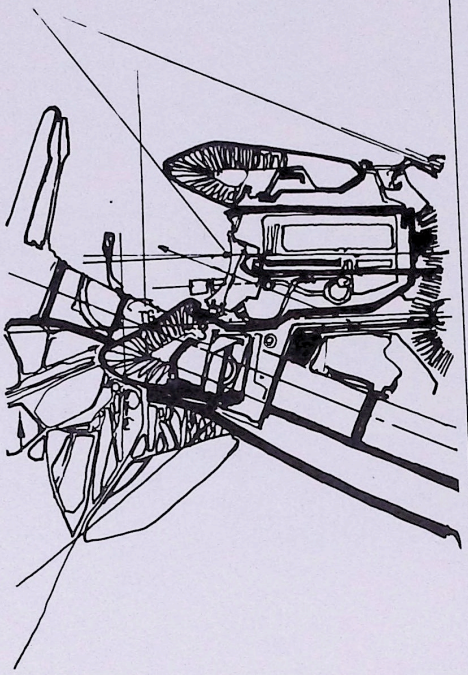
Backing lights are concealed behind stainless steel foil—photoelectrically etched with virtually invisible perforations. When lights are on, the foil becomes transparent. The rear door, hinged at the base, drops to horizontal position, providing a substantial extension of the cargo floor. It is controlled automatically from the driver's seat.

OTHER SPECIFICATIONS

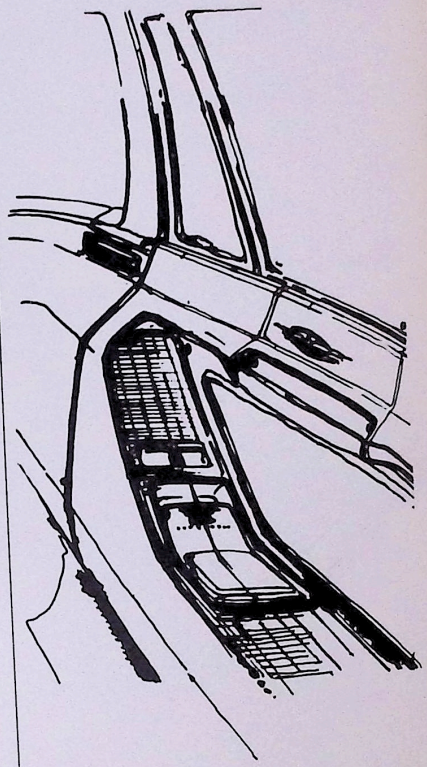
BUMPERS—USS PAR-TEN High-Strength Low-Alloy Steel
BUMPER BRACKETS—USS EX-TEN High-Strength Low-Alloy Steel
UNDERBODY—Steel Sandwich Panel
FIREWALL—Steel Sandwich Panel
CARGO DECK—Steel Sandwich Panel
DOOR PANELS—Adhesive Bonded
INNER DOOR PANELS—Embossed Carbon Steel
MUFFLER—USS 100 Stainless Steel and aluminum-coated Steel
TAIL PIPES—USS 100 Stainless Steel
BRAKE LINES—Tubular Steel
WHEEL HUBS—Cold Formed from USS Low-Carbon Steels
REAR SEAT—Torsion Bar Design
WHEELHOUSE COVERS—Embossed Carbon Steel Sheet
STRUCTURAL FASTENERS—USS Low-Carbon Martensitic Steels



CONTROL PLATE



MOVABLE CONTROL CONSOLE



STAINLESS SEAT TRIM

INSIDE...STEEL'S SOFT TOUCH

Steel leads from strength. That is the basis of its contribution to interior styling as well as structure. The diversity of its forms . . . the many types of USS steel . . . their ability to combine with other materials give the engineer and stylist a wealth of opportunities to blend esthetics with function and safety—luxury with permanence and economy.

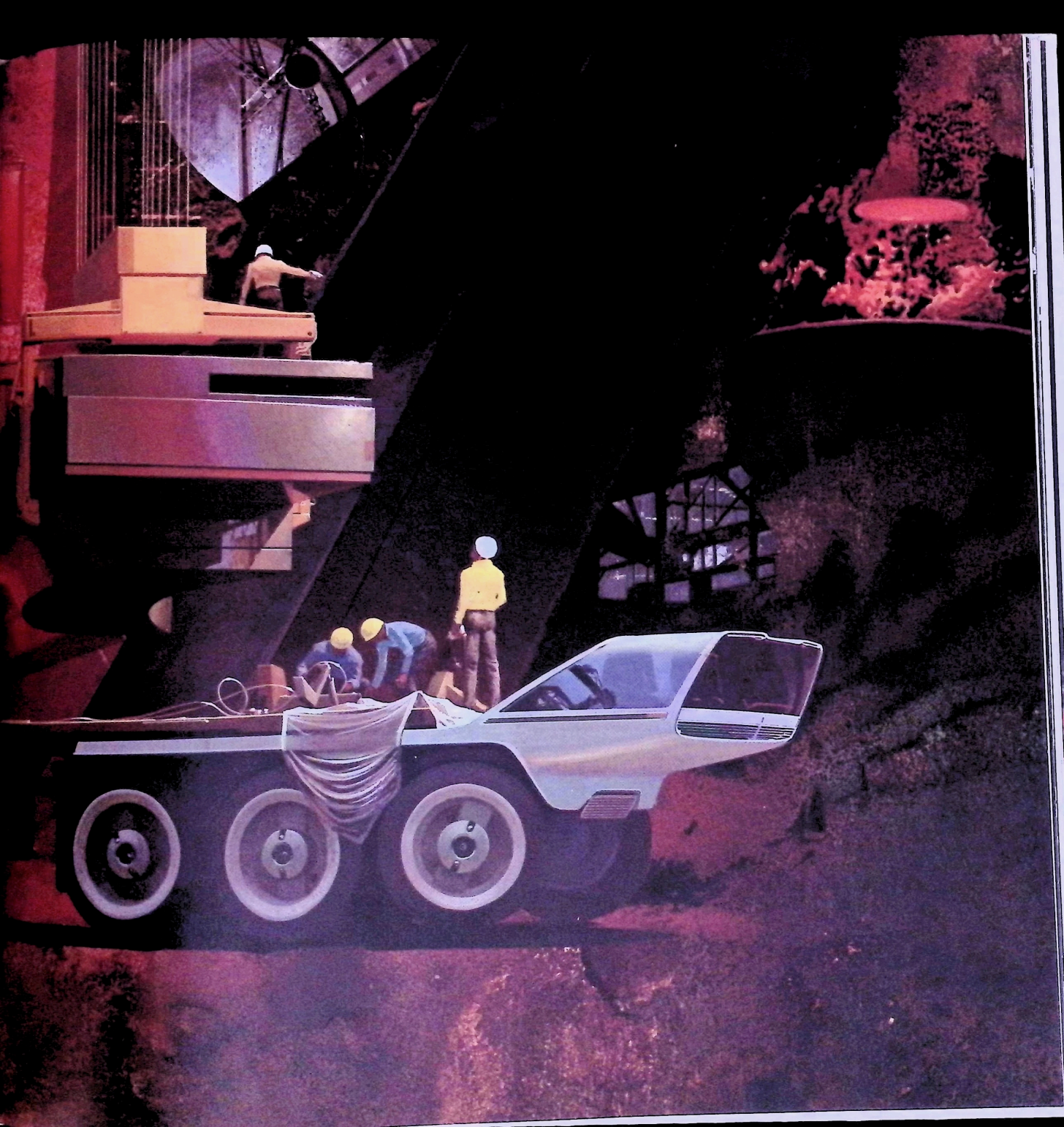
In the USS station wagon, the front seats are independently adjustable. The design and construction of the rear seat is the result of a special study program. This seat employs both torsion springing and wire under tension to produce optimum passenger comfort. Perimeter wire framing of the seat and back cushioning gives a yielding edge to the seating, and adds greatly to under-leg comfort.

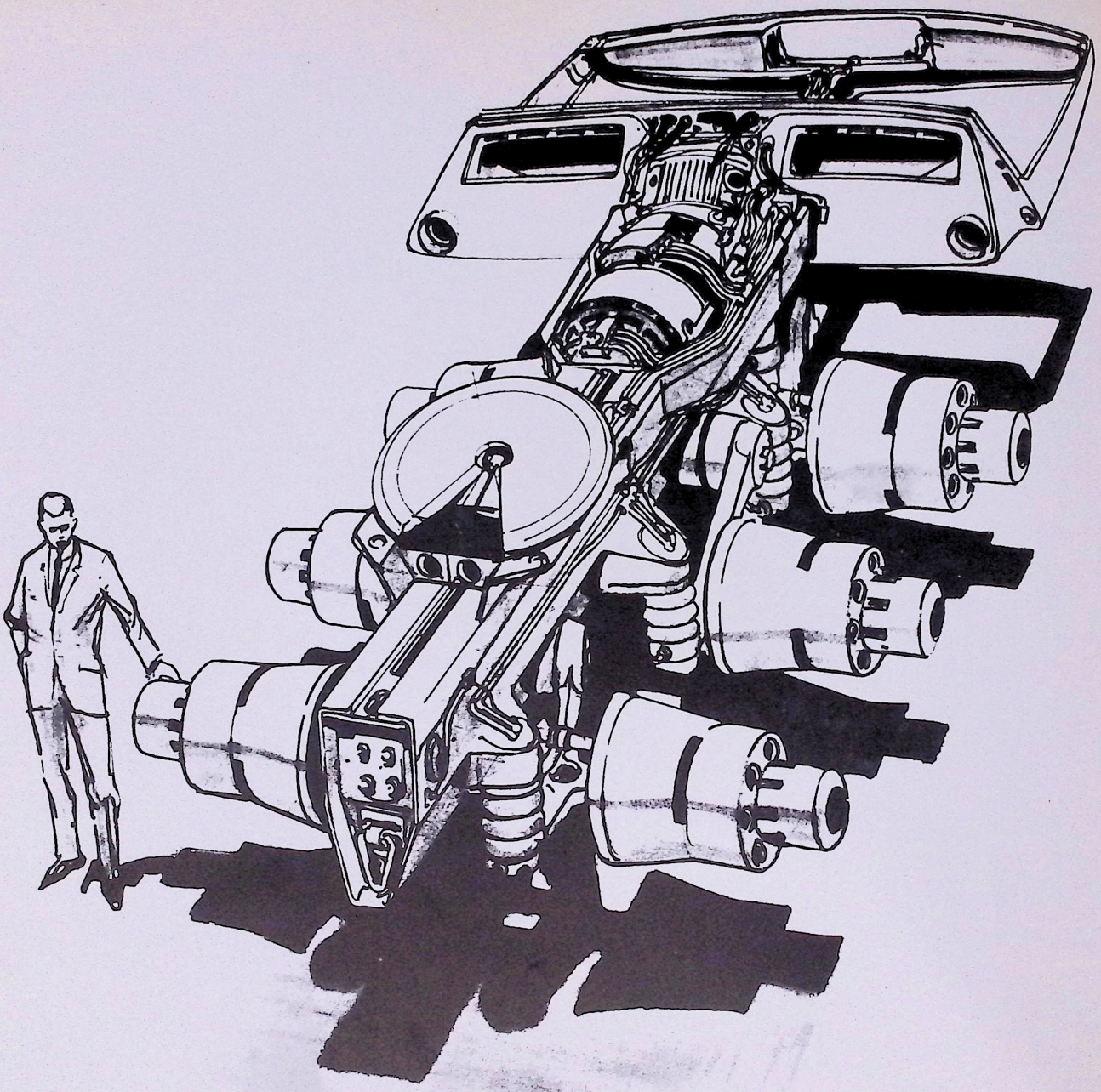
A SAFER PACKAGE

Many USS studies are devoted to the problem of passenger protection in the event of collision or other mishap. This is a continuing and probably endless program. In common with the intensive efforts of the automotive industry, United States Steel will maintain its program of innovation in this much discussed area.

In the station wagon, driver safety is enhanced by recessed instrumentation. The instrument panel, constructed on a base of steel wire mesh, is rigid yet soft. There is a collapsible or breakaway steering arrangement. The seat belts have attachments of alloy steel, exceeding today's requirements. The frangible sun visor is mounted in a position where bodily contact is unlikely.

This wagon was made to show that steel has the potential to satisfy all the engineering, styling and safety requirements of tomorrow's cars. Although it will never transport a passenger, we believe this wagon will convey the concept that steel is the material of innovation for the short and long range future.





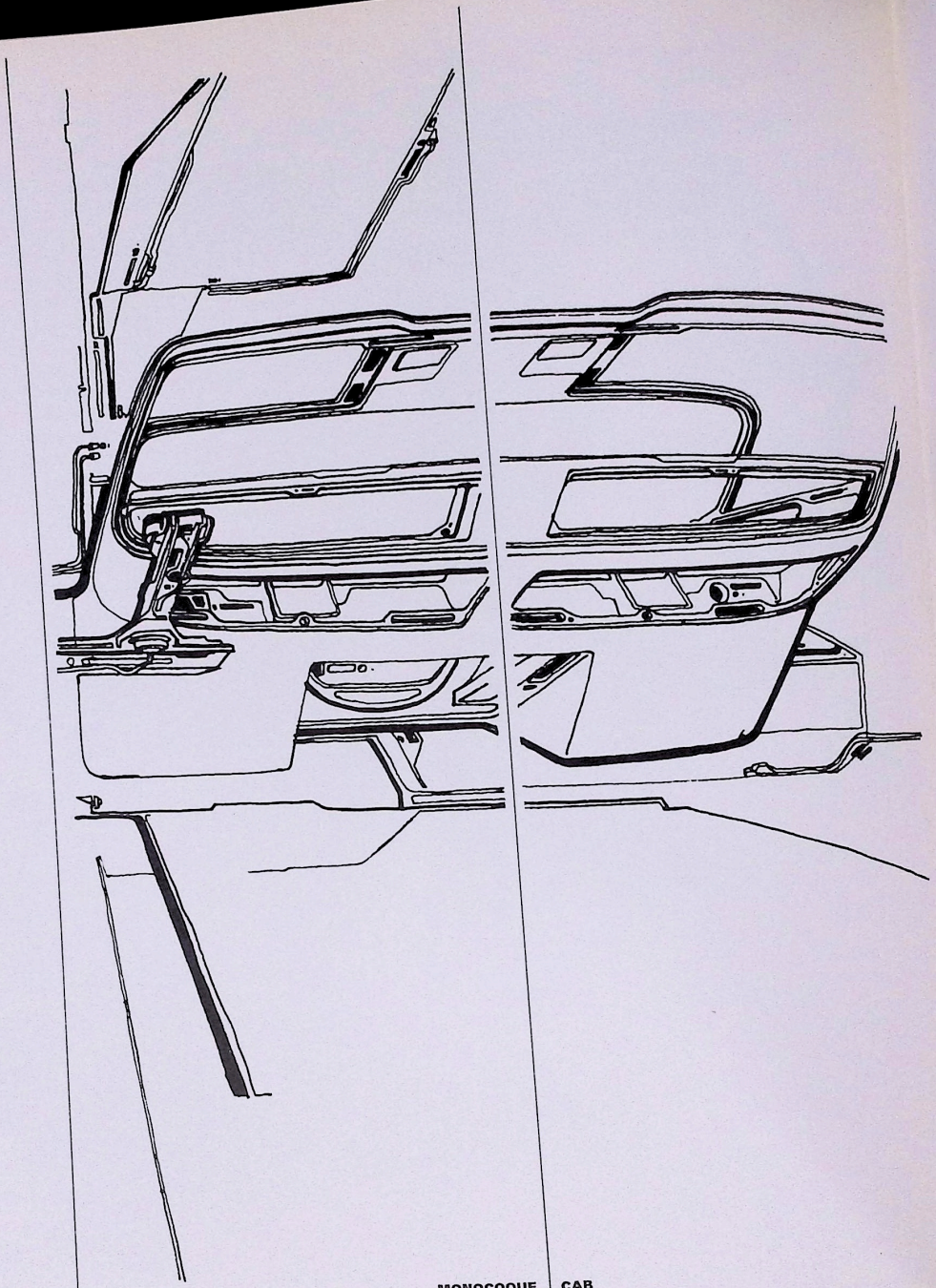
STEEL FOR TOMORROW'S LOADS

Ten years ago, the median speed of a truck on a main highway was 45.8 m.p.h. Today it is well in excess of 51 m.p.h. And, in the same span of time, 223 billion ton miles of freight carried per year have grown into an estimated 400 billion ton miles. Tomorrow's loads—greater in volume and moving even faster—invite and challenge the automobile industry to innovation and improvement in truck design and engineering.

Starting with the economic fact that *only the payload is billable*, the designer faces an exercise in freedom and discipline: freedom to innovate in form and function . . . discipline to observe the economics of load carrying. With these parameters as a guide, USS Design Study Programs involving truck design are underway in many categories.

Removing deadweight from structure and body to increase payload; increasing cubic content without sacrificing strength; increasing utility while minimizing maintenance; making greater use of legal limits: these are the opportunities available through the use of the USS Family of Steels. In their various types, formulations and forms, these specification materials can place strength and stamina where needed. In optimum balance, and at a reduction in weight and cost.

The technique of spin riveting is under intensive study and test. One objective is to develop improved ways of joining structural members for maximum resistance to racking and stress failure. Another is to introduce the use of tubular steel preforms as a replacement for more costly forming methods now being employed in the production of wheel hubs, tubular axles both driven and non-driven, and other circular assemblies.



MONOCOQUE CAB

The potential of monocoque cab construction is the subject of still another USS study. In this concept, the steel "skin" of the cab serves as both structure and enclosure. Customary framing members are minimized, with no loss of cab strength or rigidity. The advantages of such construction include weight saving, lower cost, and added room inside the package.

Engine failure on the road, while infrequent, can be a costly episode in the life of a carrier. A current Design Study Program takes on this problem, and is evaluating the possibilities of designing the truck chassis in such a way as to permit the rapid removal and replacement of a disabled engine.

Called "perimeter framing," this innovation envisions a cradle structure containing the engine and transmission. A limited number of linkage points: drive shaft, electrical harness, etc. are designed for quick disconnect. An engine changeover, then, can be made in minutes. A new engine-transmission is dropped—the removed one is serviced on the bench—and the down time becomes less of a charge against cargo revenue.

The "sandwich panel," discussed in a previous chapter, has important applications in truck design. Its ability to reduce weight, increase cargo space while serving in a structural capacity recommends it to the designers of tomorrow's cargo carriers.

Steel for tomorrow's loads means steel in new roles of usefulness . . . steel in new combinations . . . steel in new production techniques.

TESTING: THE LAST CHECK

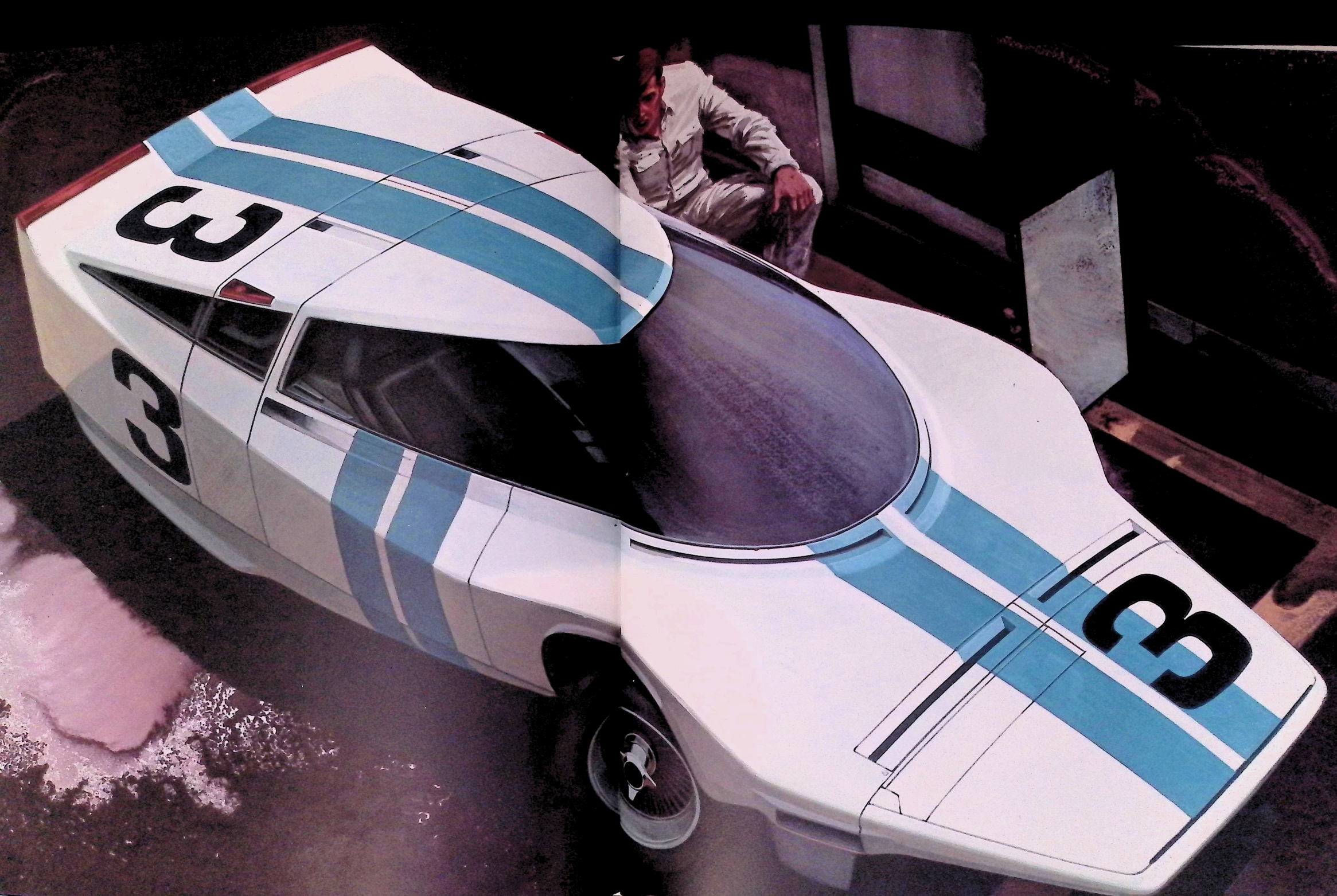
In its upper reaches, the whole of the great river Nile passes through a gorge less than 18 feet wide. Here, in this cataclysm of nature, all the things the waters will encounter on their way to the sea are experienced in concentrated fury.

The automotive industry doesn't boast an 18 foot wide gorge through which the tide of its production must flow and be tried, but it does have an equally dramatic gantlet through which the designer must route his final product. It is the performance test.

The products of our country's greatest industry have a market as big as the world. Even within our own boundaries, the American automobile is expected to operate efficiently and dependably in temperatures which range from fifty below zero to 135 above . . . in humidities up to saturation . . . in the corrosive air of an industrial complex . . . in the salty atmosphere along our thousands of miles of coast line.

The last check on the vehicle is the proving ground. It may be a laboratory where accelerated tests compress years of wear into hours . . . a torture course that quickly locates the weak spots in car design and engineering . . . the gruelling road test which comes closest to duplicating the actual service life of the millions of counterparts of the vehicle being tested.

Testing, the last check, is the first step before production.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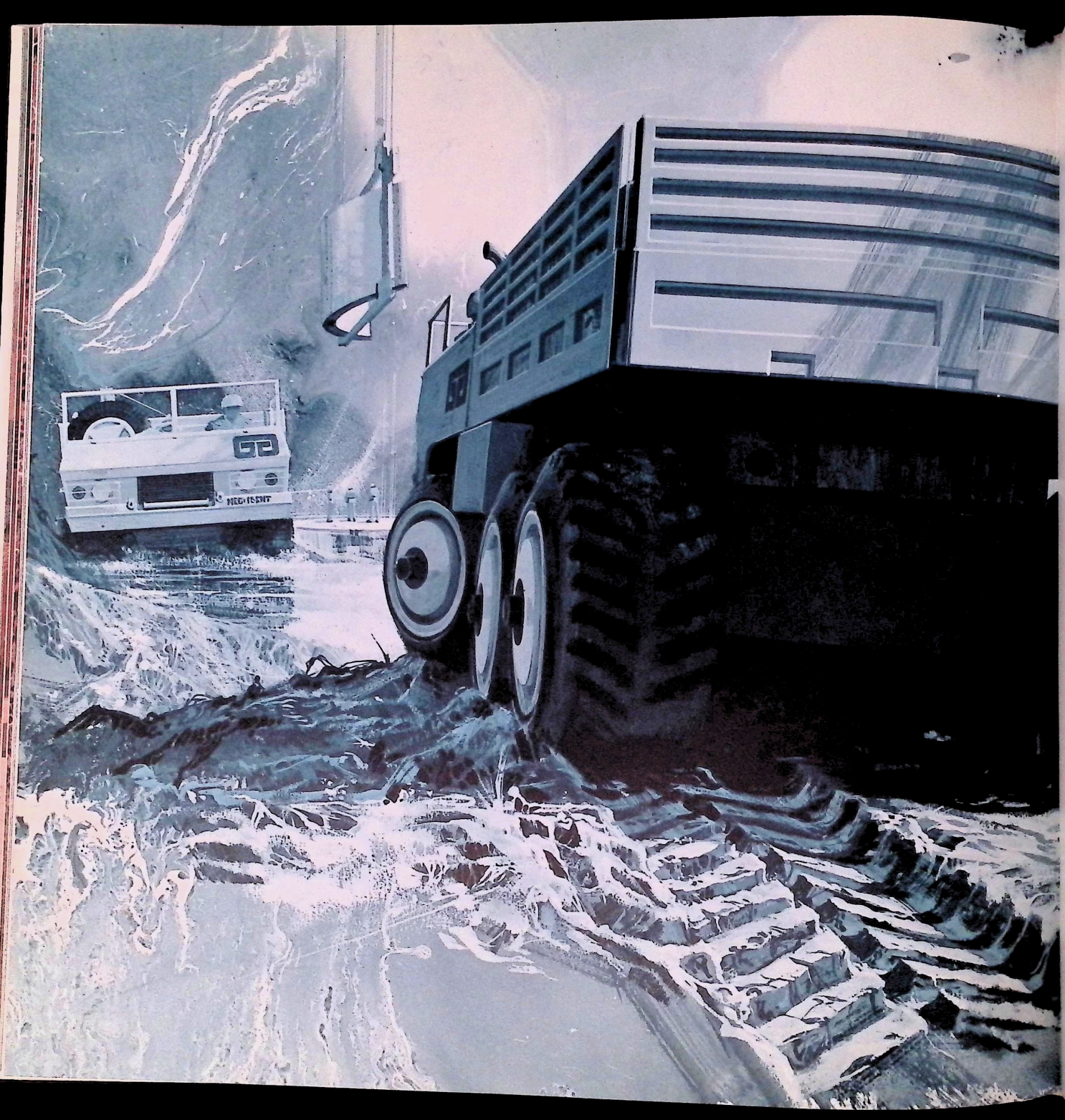


ENVIRONMENT: THE PROVING GROUND

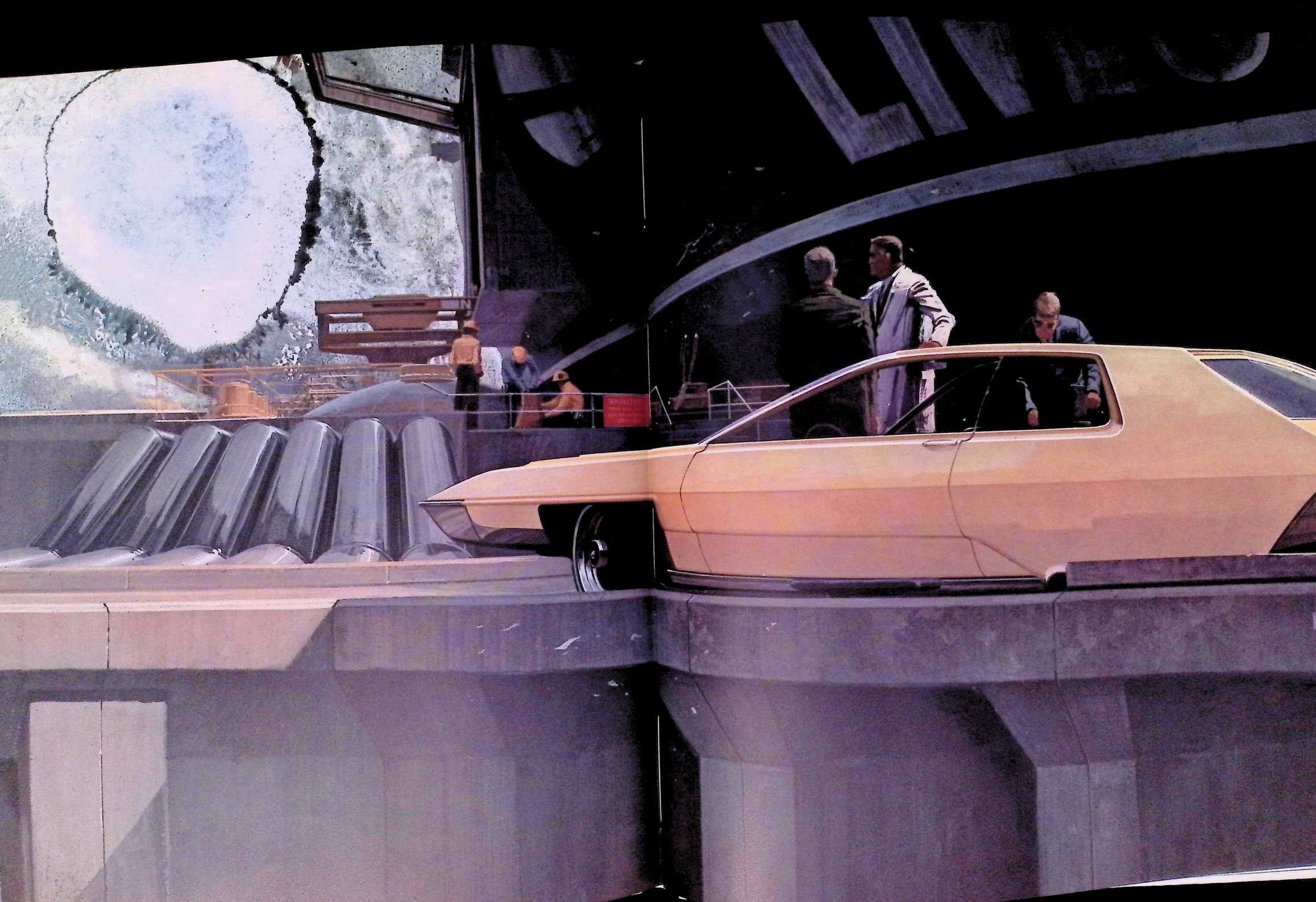
Both man and his vehicle are ubiquitous. Scarcely a spot on the map is too remote—too inaccessible—for this partnership. The ensuing illustrations of a busy dockside . . . a white mantled mountaintop . . . a dust-dry desert only hint of the many environments where man's numerous interests and activities take him and his machine.

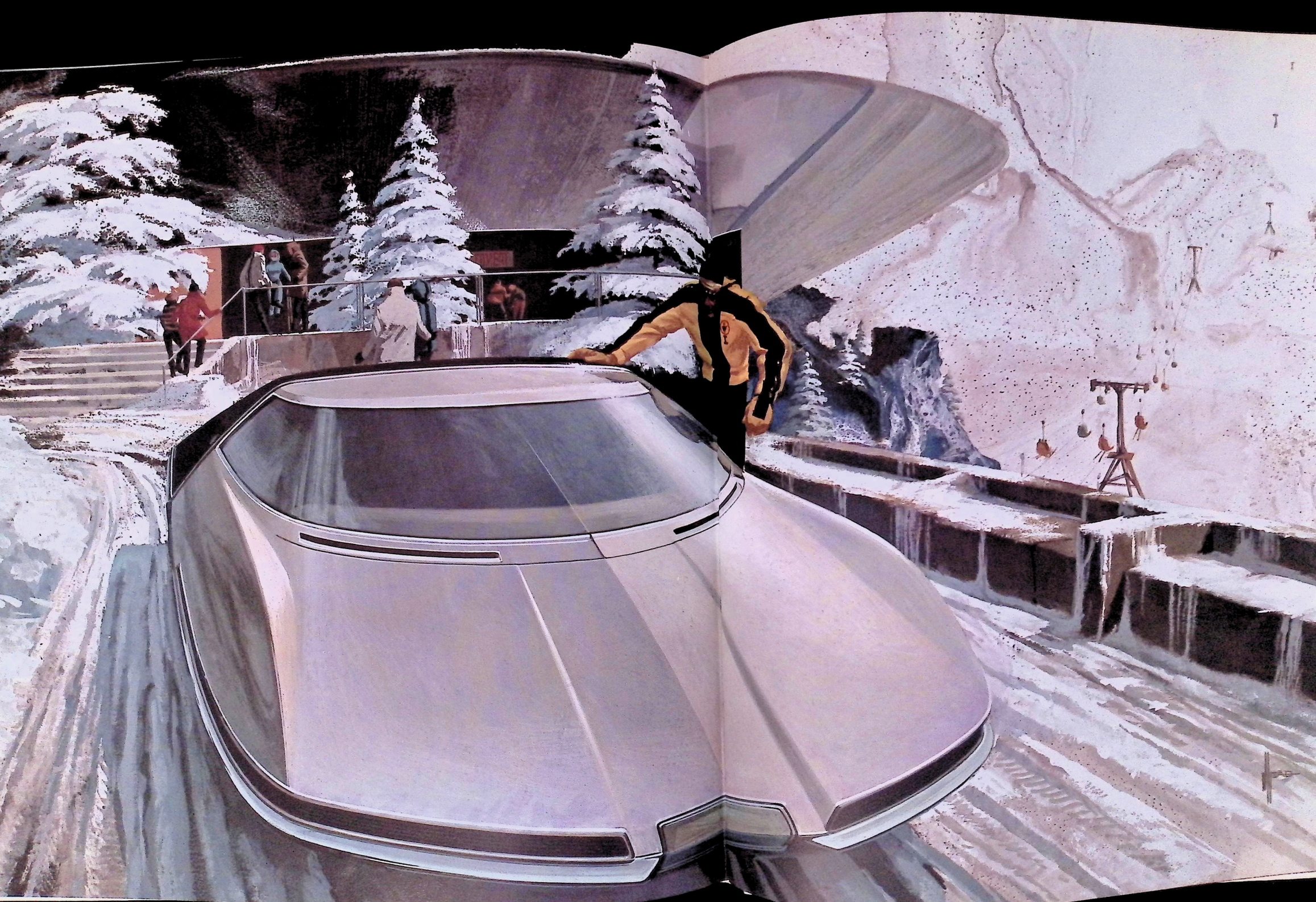
By going and being everywhere, the modern automobile is subject to a full measure of environmental conditions—with the elements continually testing the fitness of its design and the stamina of its materials. Steel, because it is inorganic and because it is engineered in thousands of types and forms to specification, can supply the needed resistance to heat, cold, moisture, corrosive atmosphere and ultra-violet attack.

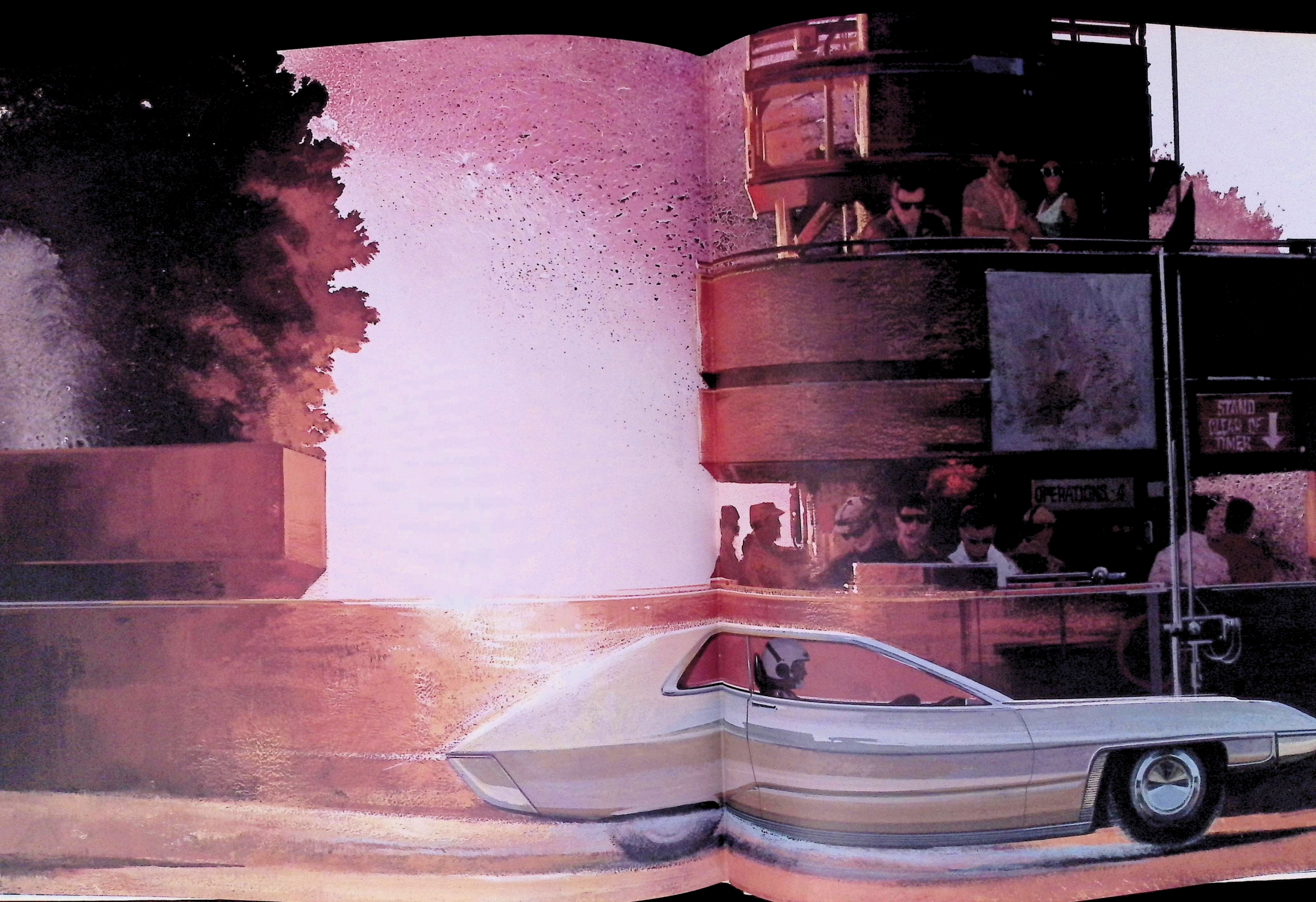
Always present and infinitely more hostile are the forces that constantly apply in the operation of a vehicle. Under the hood temperatures reach into the thousands of degrees. Parts face shock, compression, abrasion, expansion and contraction, and chemical and electrolytic attack. Here is where steel finds no counterpart in its ability to meet these conditions on balance—with optimum performance and economy.

If the problem is one of high tensile yield, a USS alloy steel can supply the answer with strength to spare and a reduction in weight. If it is corrosion, there's a High Strength Low Alloy steel such as COR-TEN, any of a score of stainless types, or combinations such as galvanized, terne plate or chrome plated. Other problems of high temperatures, abrasion, resiliency, compression and expansion can best be solved with steel.

The end result is confidence in the vehicle and its engineering. The forbidding environment becomes tolerable, and the inaccessible spot reachable.






STAND
CLEAR OF
DOMES
OPERATIONS 4

DESIGN VS. COST

The limitations which economics impose on the designer and engineer frequently act as a stimulus to innovation. This volume serves to introduce many of the United States Steel programs devoted to automotive design. Most if not all of them involve cost savings, while they advance important production and esthetic advantages.

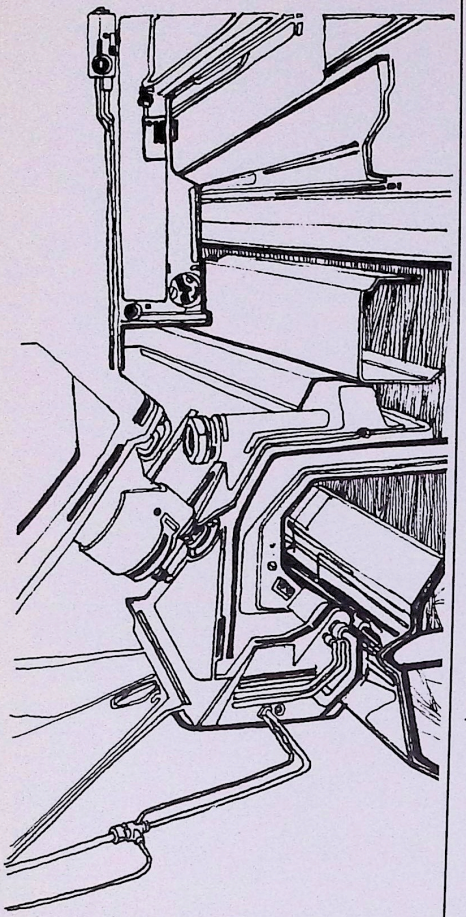
Design vs. cost does not imply a contest as much as it does an arrangement—an arrangement where the result is a gratifying balance of function, form and thrift.

Embossed carbon steel sheet is typical of the design vs. cost concept. Already proved out in current models, its merits are such as to make it a standard method for obtaining interior effects in harmony with the stylist's point of view and purpose. Leather and other embossed relief . . . etched designs . . . perforations—all of these are possible with carbon sheet steel.

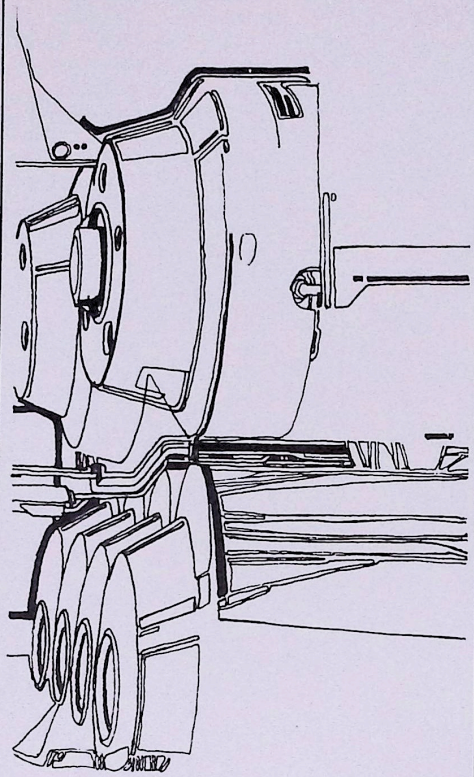
USS 100 Stainless Steel for mufflers and tail pipes has all the identifying marks of a problem solver. USS 100 is an inexpensive grade of stainless steel with high heat and corrosion resistance. It can provide a welcome, economically sound answer to the problem of handling higher exhaust temperatures. Current developments in smog control indicate a place for USS 100 in engineering exhaust units.

Another USS program concerns the economics and feasibility of incorporating steel banding or ribbing in molded rubber battery cases. Such a construction could virtually eliminate case fracture—without appreciably adding to overall costs.

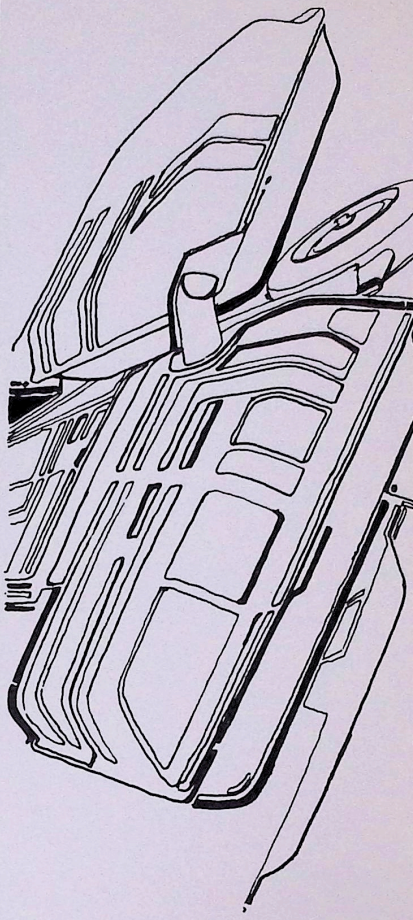
These studies are representative of the continuing potential of steel to come up with new and better answers, when design and cost must be in balance.



USE OF PREFORMED STEEL PROFILES



COLD FORMED WHEEL HUBS



TERNE PLATE GAS TANKS AND AIR CLEANERS

PRODUCTION ADAPTABILITY

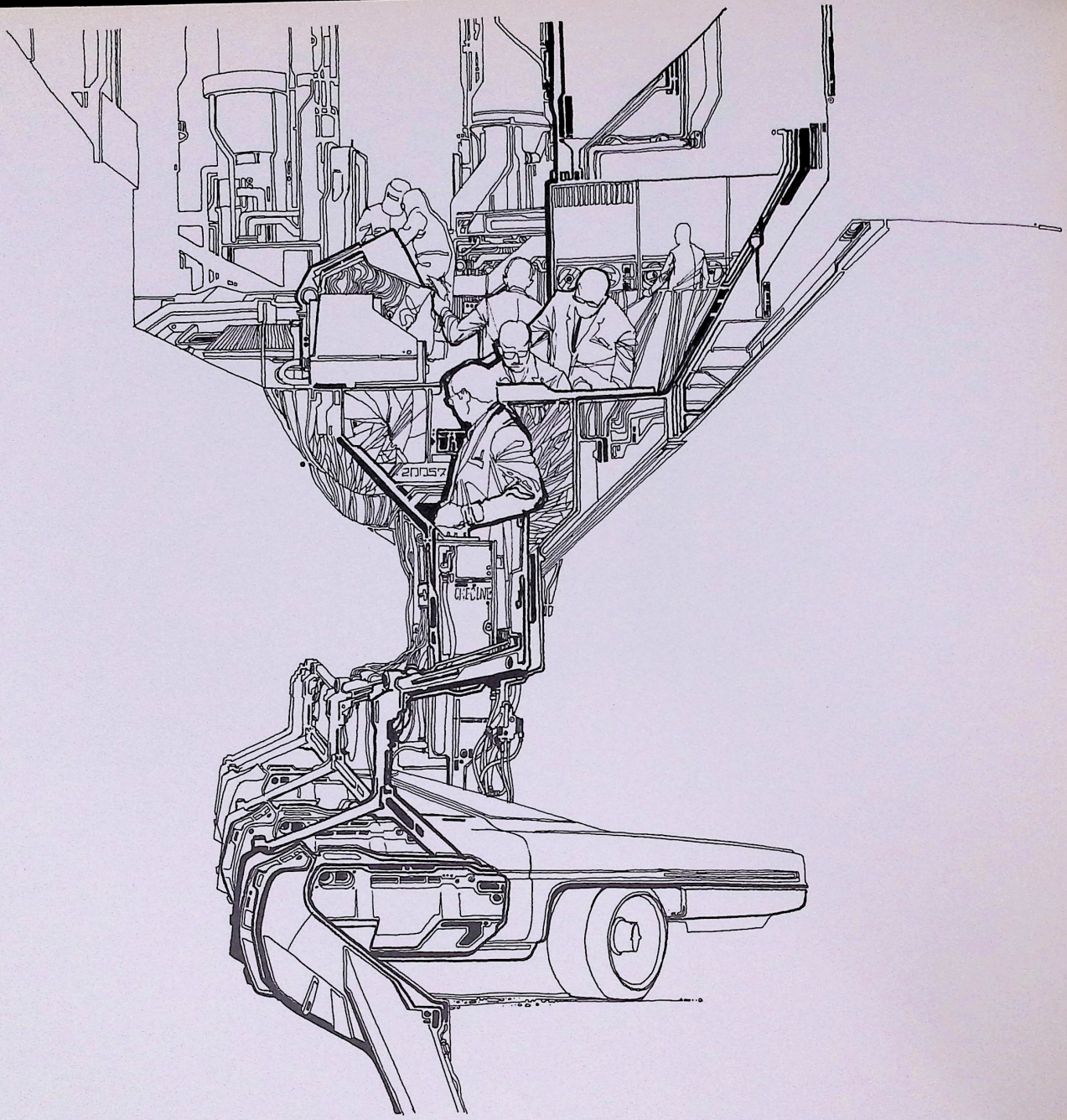
Many concepts, using design innovation to reduce costs, obtain this ideal through their adaptability to familiar production practices. The concept of rolled sections for transmission parts, frame side rails, etc. is illustrative of this. Using preformed steel profiles as stock, such parts are well on their way to finished form at the moment of being cut from the shaped stock. Thus, cost-adding production steps can be significantly reduced.

Cold forming of parts offers several advantages over casting. Reduced scrap loss and fewer production steps are important examples. Wheel hubs cold forged from low-carbon steels are the subject of a special study aimed at improving the economics and the performance of the present cast hub. Tubular steel products, in basic shapes, can be used economically for such items as gear parts, piston pins, bearing races, steering shafts and reaction shafts.

The use of USS Long Terne sheet for gas tanks and air cleaners gives performance benefits as well as production economies. The coating of this low carbon product is 85 percent lead and 15 percent tin. The steel strength and thickness, and the uniformity of the Terne plate, provides more than adequate performance, and its excellent lubricity makes for easy drawing or forming.

Rocker panels of galvanized steel deliver important corrosion and abrasion resistance, and do it with economy.

Possibly more than any other material, steel possesses the attribute of production adaptability. So much has been done with it . . . so much can be done with it. Steel holds no secrets for the designer and engineer. For years, they have been solving problems with steel . . . depending on it, and continually improving on ways and means to make the utmost of its potential and its variety.



MEN BEHIND THE MATERIALS

The modern vehicle: thousands of parts . . . thousands of opportunities to do things better, to lower costs, to innovate with boldness.

At United States Steel, this multitude of opportunities is the stimulus behind the comprehensive program of metallurgical and application development devoted to automotive subjects. It is a program that involves USS laboratories, pilot plants, production centers, engineering and marketing groups.

The question: what makes a better automobile is directly related to another: what makes a better steel. And another: what makes a better method for applying that steel to automotive production.

The men who make and sell USS products consider that the production of the major automotive material is only the first step in a complete service to the industry. What is the right steel for the application . . . what design improvements can it inspire . . . and how can it lower costs are questions of significant importance to the men behind the material.

The Automotive Marketing Group of United States Steel is a good place to start when your design and engineering ideas are looking for an understanding and enthusiastic ear. The men in this group—with backgrounds in engineering, design, styling, materials and production—are looking for you. They have access to the finest metallurgical laboratories in the world . . . the most complete dossier of automotive information of any material supplier. What they sometimes lack is awareness of your particular problem, although they may already be working on it unknowingly.

The only way to find out is to ask them.

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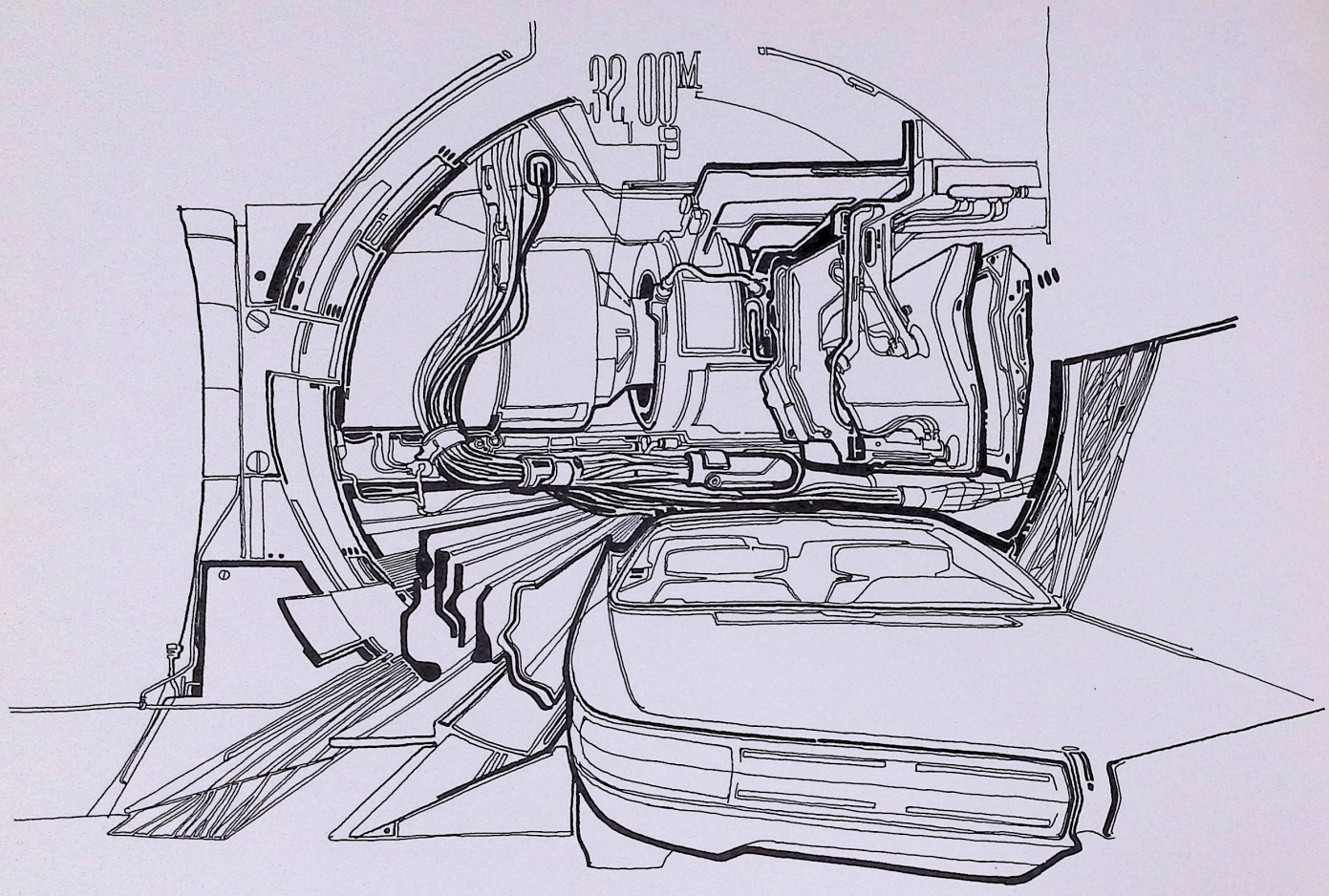
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BANK ACCOUNT IDEAS

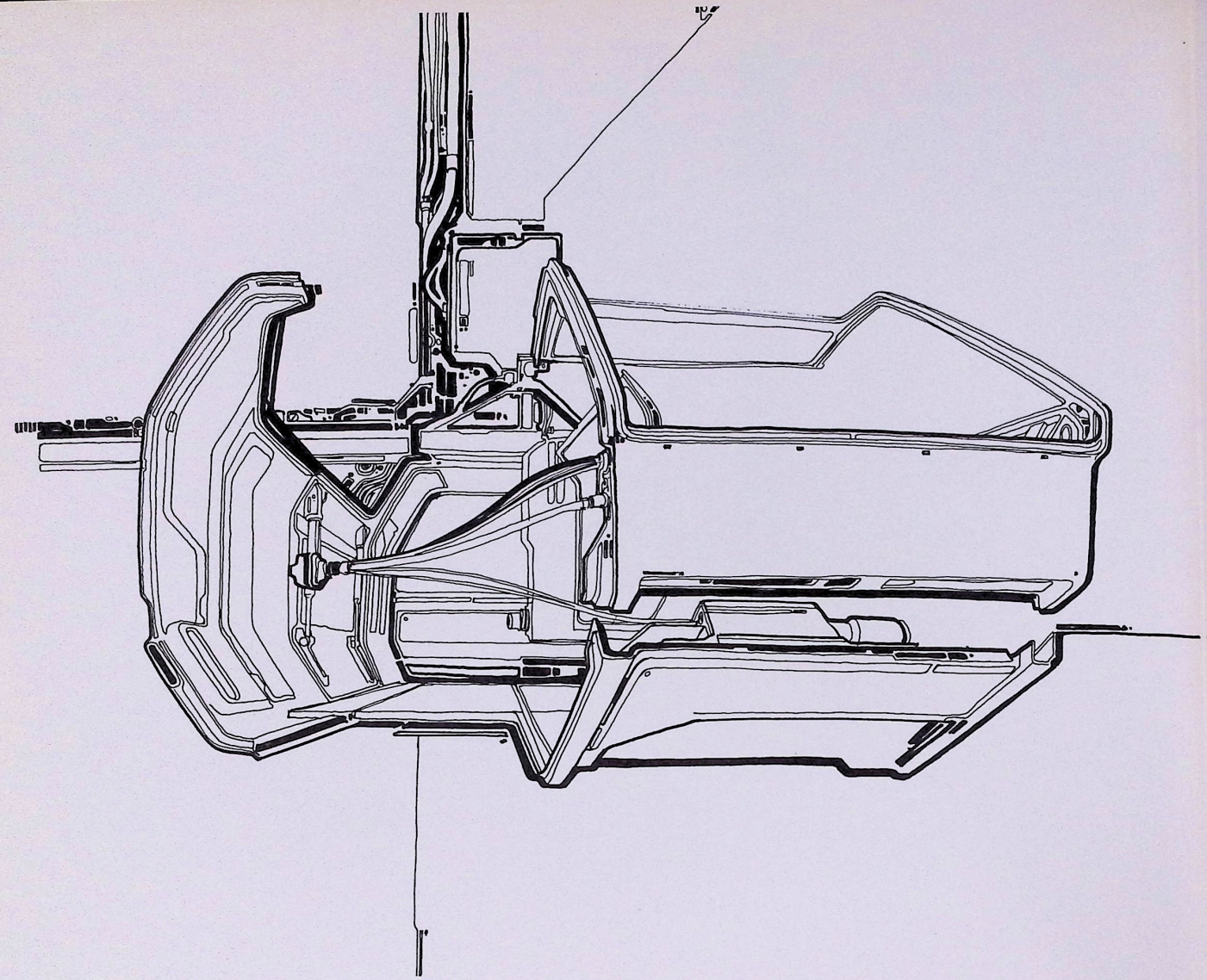
Some forty USS Design Study Programs are reported on throughout this volume. Many of them relate specifically to developments in steels and steel in combination with other materials. Others range farther afield, and involve innovations in design, engineering and techniques of production.

These, in total, are the "bank account" ideas by which United States Steel undertakes to place its comprehensive facilities at the service of the automotive industry. They constitute the current crop of a steadily increasing number of studies of automotive manufacturing problems which tomorrow's requirements inevitably will pose.

Leading this group of bank account ideas is the family of steels concept, which seeks to achieve a high level of design and performance through the employment of specific types and forms of steel in optimum balance. The end result: a matched ensemble of design, function and service life for the assembly or the part. The economy of such a concept is obvious.

In techniques of assembly, the adhesive bonding of metal to metal, and metal to non-metal, promises substantially to reduce assembly time and overall cost.

Another USS Design Study Program is devoted to the development of spin riveting and its potential for creating structural rigidity.

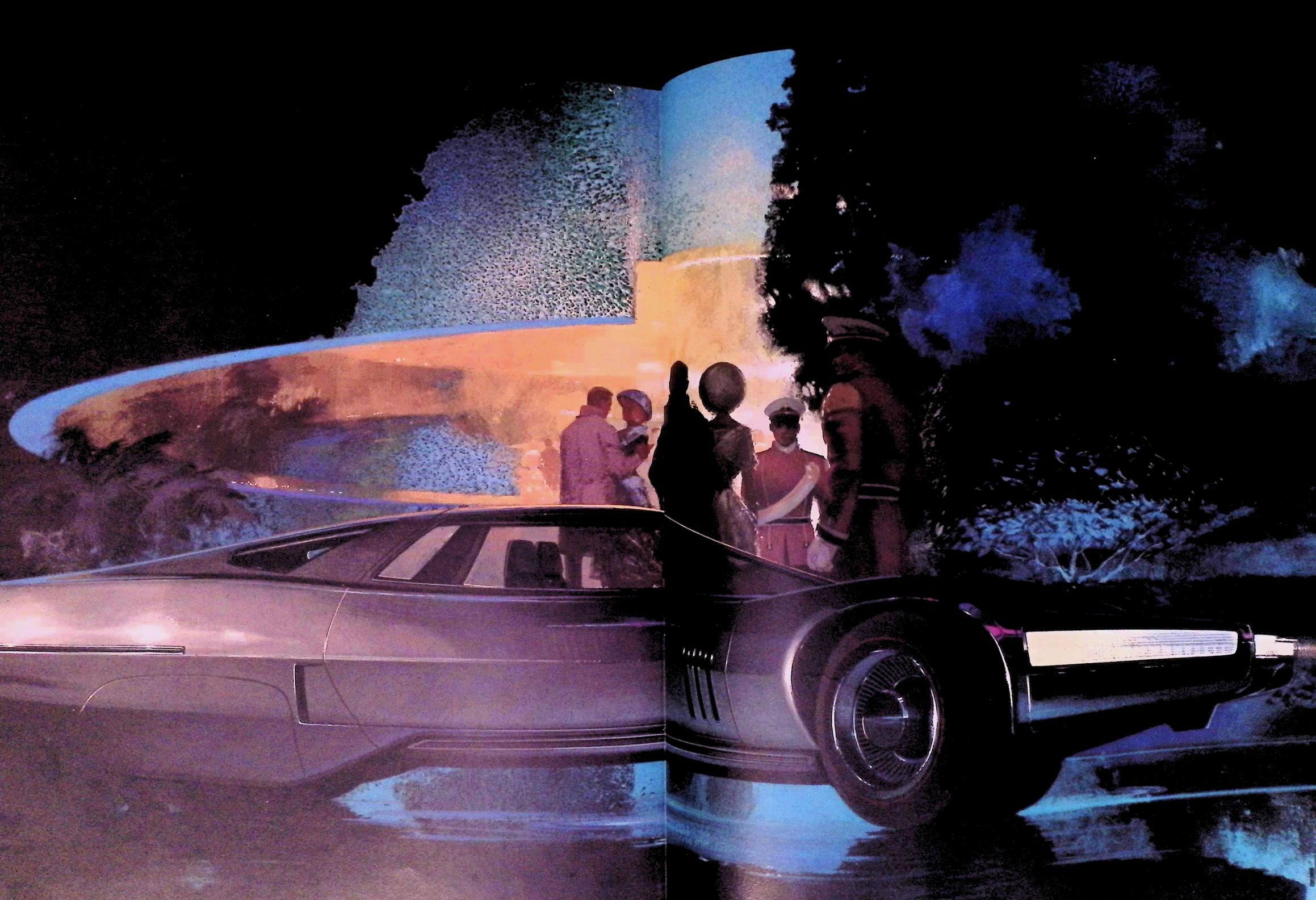


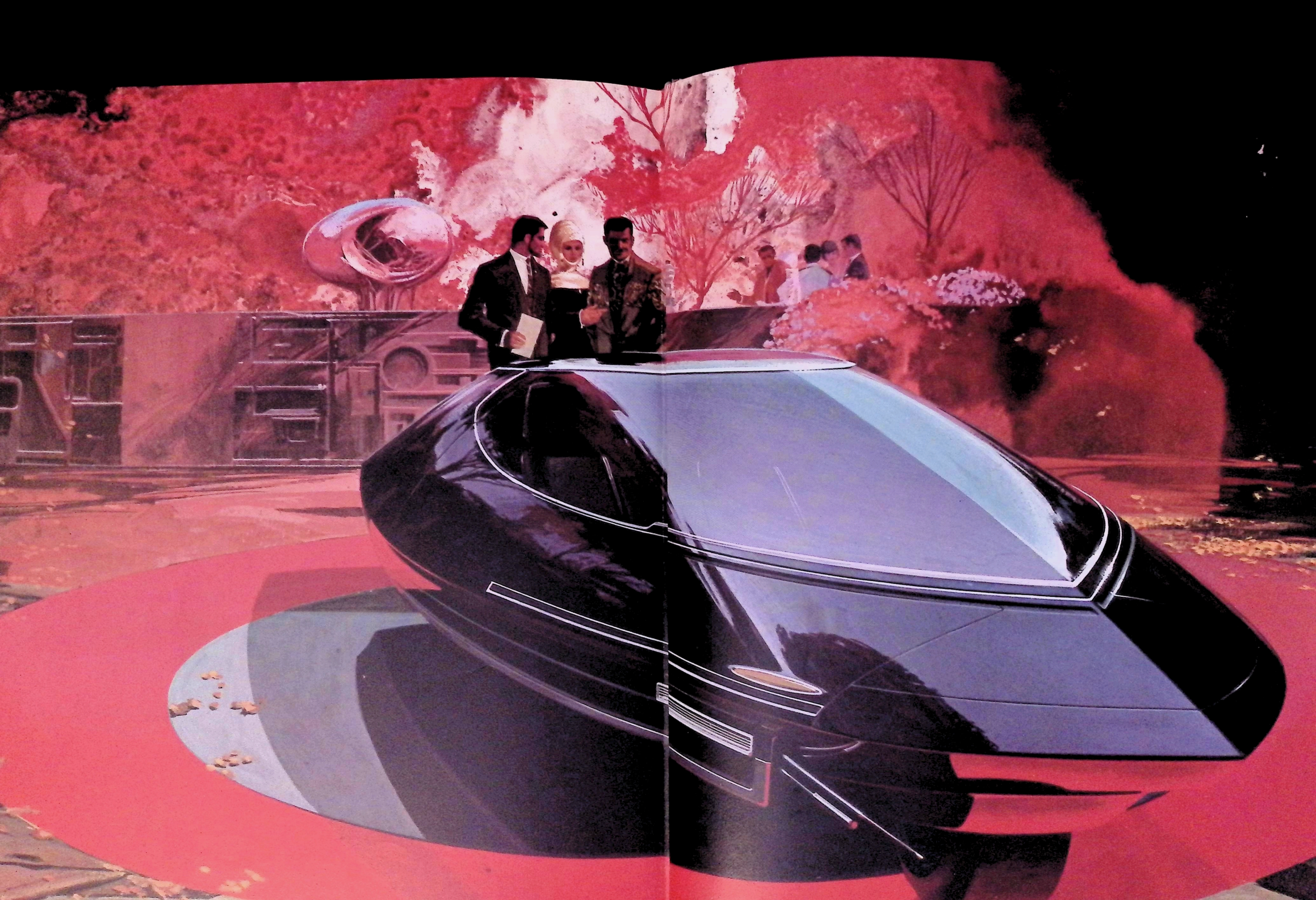
Cold forming, or rolling, from standard steel shapes—bars, rods, tubing and plate—is another bank account idea under intensive investigation. Starting with metallurgical research, this program embraces the whole area of feasibility, production-time comparisons with current methods, cost and performance. For connecting rods, shift fork, valve lifter arms, axles, wheel hubs, bearing and gears, the technique of cold forming looks to be a takeover.

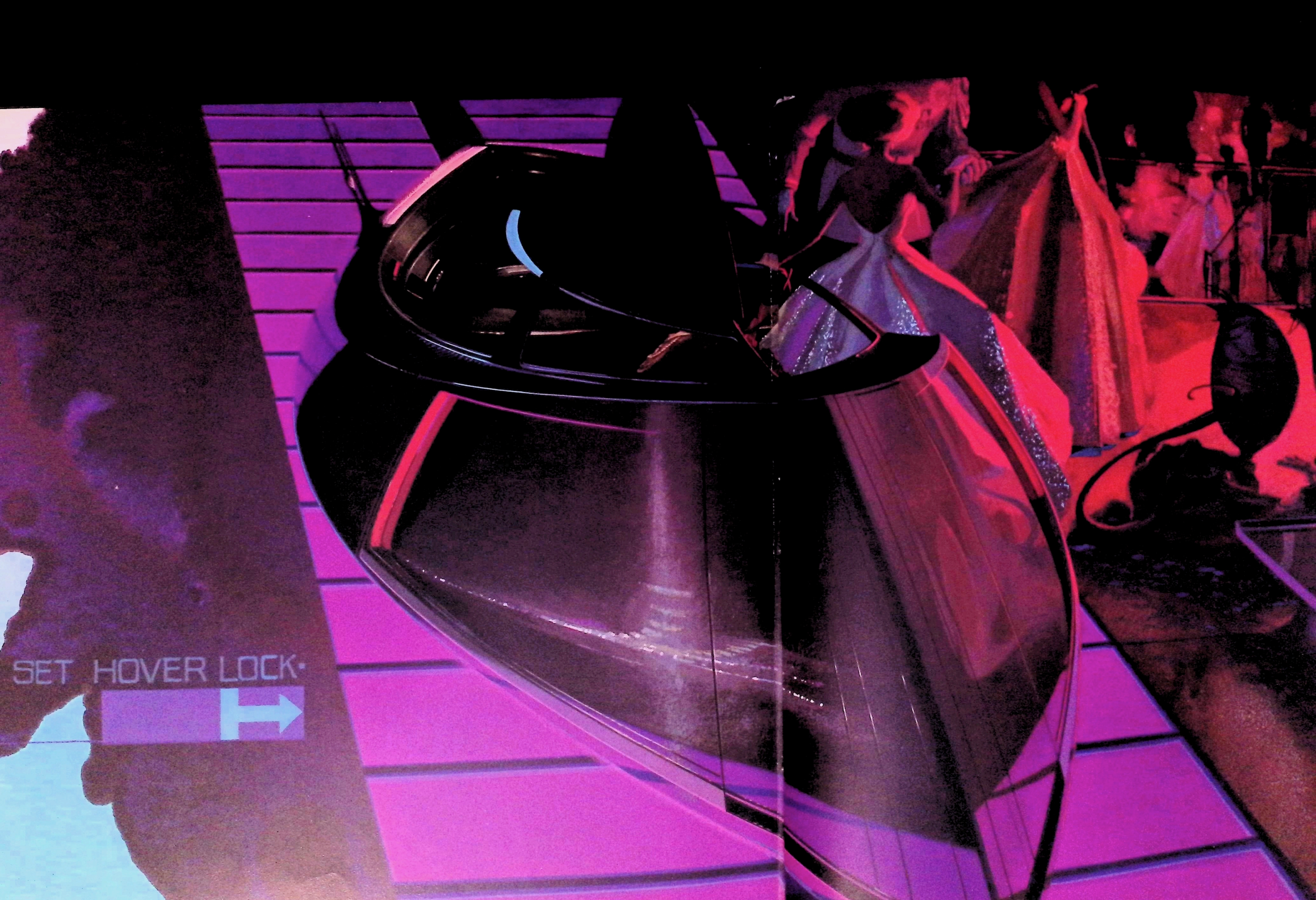
Pilot production lines which use steel-fiber dies loom as more than a possibility according to a current Design Study Program. The economic advantages of such a development are considerable, and the time saved in die-making could be revolutionary.

Steel wire for electrical harness may be the preferred way to carry current in tomorrow's vehicle. Good conductivity, resistance to vibration and shock, and lower costs are indicated, as voltage requirements increase.

Along with these bank account ideas, which are well advanced at United States Steel, are many new and exciting concepts. Call them innovations, or just say that they are a part of USS service to the automotive industry. The objective is the same: to keep steel contemporary . . . to make this basic automotive material the number one solver of coming engineering problems.



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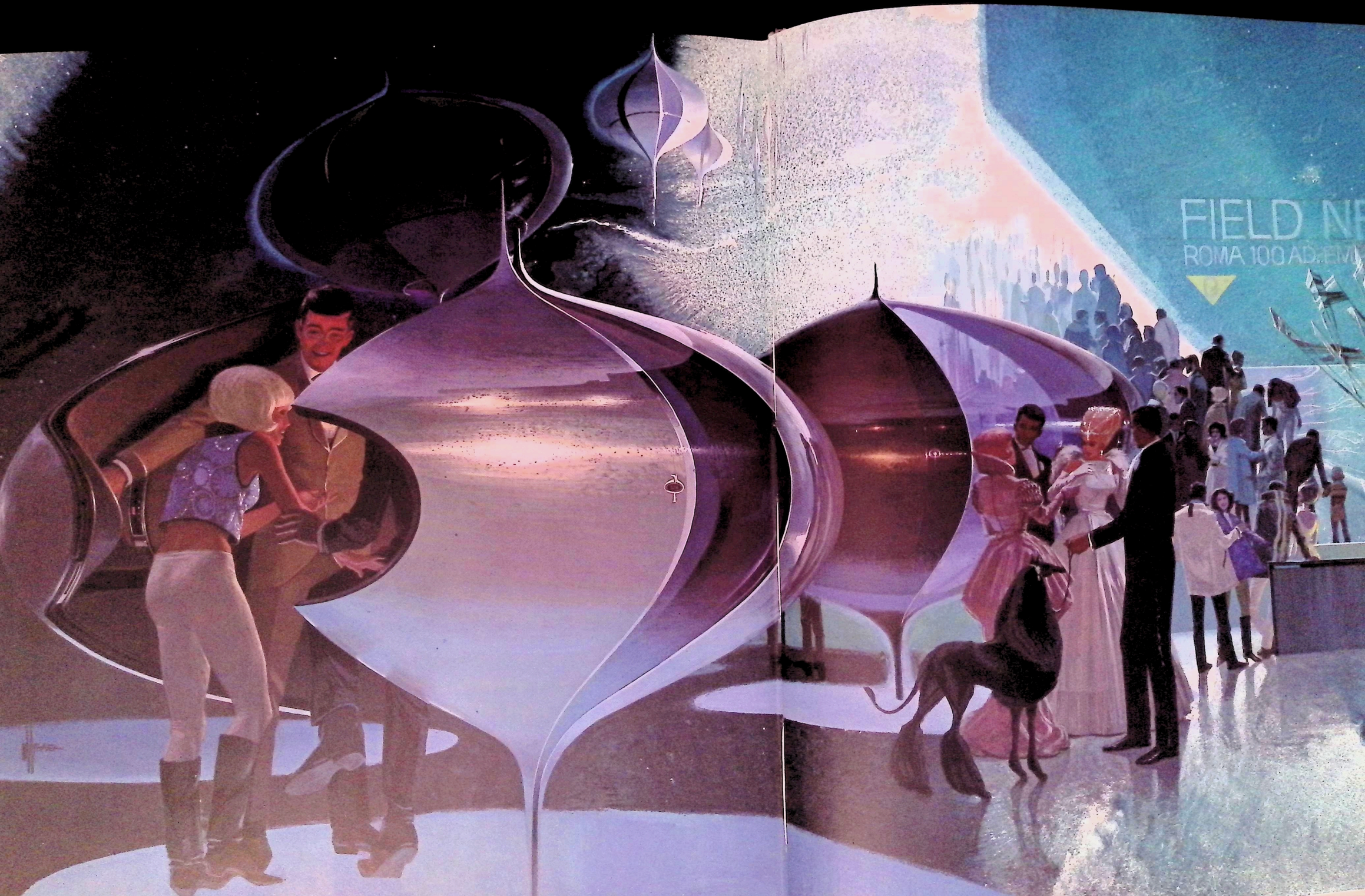
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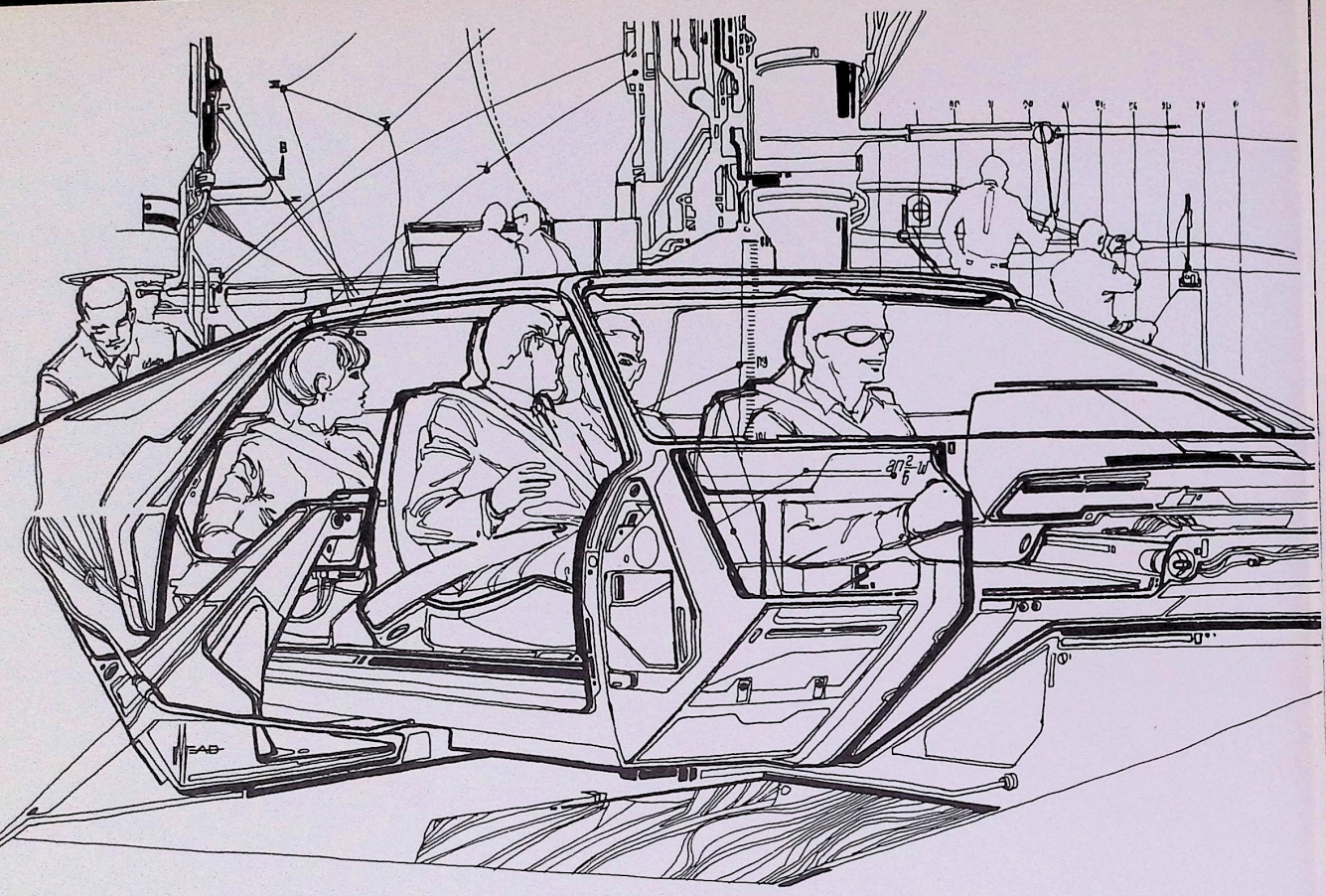


STEEL IN THE KNOW

The automotive industry didn't invent the science of topology. But years before this branch of geometry was adopted by architecture and other disciplines, the automotive industry was employing its principles to create the vehicles as organic expressions of power and movement. The result: machines of infinite complexity . . . a harmony of function and form . . . producing power from fossil fuels . . . converting it into energy to travel . . . warming its passengers in wintertime and cooling them in the summer . . . creating electricity for light, communication and entertainment . . . and all in a package engineered to move along the highways with a minimum of friction and maximum comfort for its passengers.

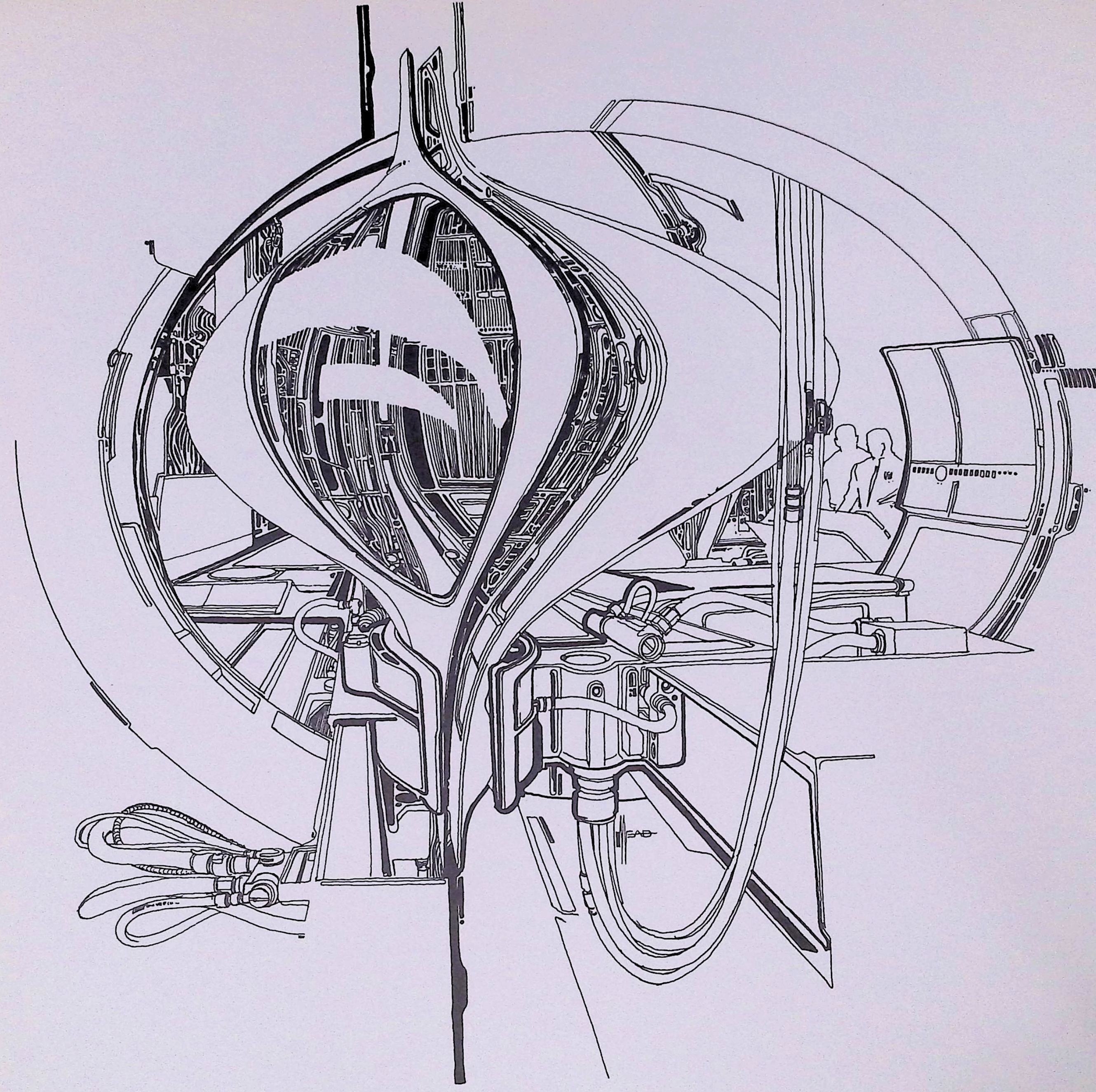
Having produced this miracle by the millions every year, the team of designers and engineers responsible for it ignores its creation and turns to the task of doing even better next year—and the next.

United States Steel—in its research laboratories, its plants, its metallurgical organization, its sales offices, and its automotive marketing group—is doing the same kind of advanced thinking with the automobile's basic material: steel.

Such innovation will keep the automotive industry forever young and responsive to the changing desires of the hundreds of millions of people whom it serves.

Innovation, too, will continue to keep steel contemporary, and in tune with change.

A deceptively simple word, *innovation*, embraces a world of creative and technological effort. For United States Steel, it means the never ending search for the better way . . . hundreds of millions of dollars invested in research and development . . . thousands of people engaged only in seeking answers for the future.



With U. S. Steel, innovation is born in research and reared in the pilot plant. Pilot plant steelmaking helps develop production refinements leading to superior product quality. Equally important, it paves the way for manufacturing and product advances that spell revolutionary changes for many industries. USS research goes all the way back to raw materials . . . to melting . . . to casting, rolling and coating.

Through the many Design Study Programs currently underway, the Automotive Marketing Group at U. S. Steel seeks to anticipate design and engineering problems as they relate to improvements and advances in automobile manufacturing—particularly those having to do with the employment of materials in new application—both esthetic and functional.

The real benefits of this type of depth effort come when such studies relate directly to specific and urgent industry problems, and involve close personal contact with those working on the assignment.

A problem well defined is a problem well on its way to a solution. U. S. Steel is looking for such definitions from automobile men, and is prepared to extend its research and development services on a broad as well as confidential basis in any area where basic knowledge of steel and its potential in automotive engineering and design can make a time-saving contribution.

The Automotive Marketing Group invites your inquiries.