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# PREVENTION AND REDUCTION OF INJURIES IN TRAFFIC COLLISIONS

### William W. Harper

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One of the principles of Democritus, a Greek philosopher who lived about 400 B.C., was to the effect that "nothing happens by chance—every occurrence has a *cause* from which it follows by necessity." This ancient principle is the philosophical basis for all our present day efforts to curb the mounting traffic accident rate. Selective enforcement, driver education, and highway engineering have focused attention on *accident causes* with the aim of their ultimate elimination. Although some progress has been made along these lines, we are still confronted with accident rates of enormous proportions.

Those who have worked in the enforcement, education, and engineering phases of the traffic problem believe that if accident causes are eliminated, both accidents and injuries will cease. This is quite obviously true, but taking into account the limitations of human beings and the man-made machines in which they travel at tremendous velocities, it is doubtful if we will ever be able to eliminate all accident causes. The records clearly indicate that the time has come when we must augment present efforts with other possible remedies.

The purpose of this paper is to point out one possible new approach to the traffic accident problem. More specifically, it is hoped that this paper will stimulate interest in a much neglected aspect of traffic collisions, namely, *injury cause.* It is quite apparent that all the efforts of enforcement, education, and engineering throughout the years have been concentrated almost exclusively on *accident cause.* Little or no attention has been given to *why* people are injured in collisions.

It is evident that our reasoning has been faulty in assuming that accident cause and injury cause are synonymous. Since preventing an accident necessarily prevents an injury, it has been tempting to conclude that the same cause is responsible for both. This is not true. A blind intersection may be the cause of a collision, but the intersection does not cause a skull fracture. Injury cause is a separate and distinct entity. This reasoning leads us to the question: If accident causes cannot be entirely eliminated, can anything be achieved by an attack on injury causes? In other words, if we cannot stop accidents, can we do anything to prevent injuries and deaths when accidents do happen?

In order to explore the possibilities along these lines a study was undertaken, following World War II, of the causes of injuries in traffic collisions. This study was designed to find answers to the following questions:

1. What are the direct causes of injuries and deaths in traffic collisions?
2. Can injury and death causes be reduced or eliminated by any means?
3. Could legislation be developed to protect the motoring public against these injury and death causes?

While much work remains to be done, sufficient information is now available to give at least partial answers to these questions. In each collision case which has been studied, careful examinations were made of vehicles and victims. This made it possible to correlate the particular injury with the mechanical aspects of the collision. This procedure not only produced direct information as to the cause of injury, but it also permitted an evaluation of what type of protective measures might have reduced or prevented the injury from occurring.

This study has necessarily been of very limited scope. It encompasses 209 collisions which the writer has personally investigated, combined with the examination of several hundred additional accident cars located in wrecking yards. Although this sampling does not provide any degree of statistical reliability, it is pointed out that one no longer requires statistical data to prove that an apple, becoming detached from a tree, will fall to the earth. Likewise, even without statistics, we can be quite certain that a sudden forward deceleration of a car will catapult a passenger against the dash and windshield. The forces operating in collisions are always the same; they differ only in direction and intensity. The same force which bruises the forehead against the dash in a quick stop of a car will produce a skull fracture at the higher intensities of crash decelerations.

Recalling the early work of Vollmer and Kreml, not until their statistical procedures of selective enforcement were put in operation did many communities realize where, when, and why most of their traffic collisions occurred. Likewise, it is believed that a systematic statistical study of *injury cause* in collisions will bring to light many startling and unsuspected facts. Once the facts of injury are exposed, intelligent corrective measures can be taken. Clearly, there can be no solution to a problem which remains hidden.

## WHAT ARE THE DIRECT CAUSES OF INJURIES AND DEATHS IN TRAFFIC COLLISIONS?

*The Physics of Injury.* Although the physics of injury in collisions involves very elementary concepts, the exact physical circumstances have many complex variations. Eliminating those cases where a passenger is crushed within a collapsed passenger space, there is generally only one basic reason for a collision injury, namely, because a difference in velocity develops between the occupant and the car in which he rides. As soon as a velocity difference develops, the occupant collides with the interior of the car and sustains injury. The greater this difference in velocity, the greater the injury. It is, of course, difficult (although not impossible) to prevent such a difference in velocity when a car suffers impact.

The actual circumstances can be best understood by a simple example of a head-on crash. Let us assume that a vehicle collides with a solid fixed object at a speed of 30 miles per hour. Let us assume further that the car is crushed in a distance of two feet. This means that the velocity of the vehicle has decelerated from 30 miles per hour down to zero in a distance of two feet. This represents a deceleration rate of 483 feet per second per second. Such a deceleration is 15 times the acceleration of gravity, which is 32.2 feet per second per second. This unit of gravity is called the G.[1] For convenience, we say that the vehicle suffered a 15G crash.

But how does the vehicle occupant behave in a such a crash? At the moment of impact he has the same velocity as the vehicle. As the vehicle crashes to a full stop he continues forward at almost the same speed of 30 miles per hour and collides with the dash and windshield. By the time his body reaches these objects they are at rest, or very nearly so. Assuming that the combined crushing of his body and vehicle interior will reduce his velocity to zero in a distance of two inches, he will have suffered a deceleration of almost 5700 feet per second per second, or 176Gs.

Although the occupant might have survived without injury the 15G crash of the vehicle, he cannot escape injury or death from the 176G crash of his body against the interior of the vehicle.

Thus, while the direct injury producing factor is always high de-

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[1] As commonly used, G is the ratio of the deceleration (or acceleration) of an object to the acceleration of gravity. It is also the ratio of the impact force to the weight of the object upon which the force acts. For circular motion, the G is the ratio of the radial acceleration to the acceleration of gravity.

celeration rates, the velocity difference previously mentioned is the first phase of the injury process.

The physics of injury tells us something which seems paradoxical: If the occupant *wore* the car, as he would a suit of armor, the crushing of the car exterior in a collision would absorb tremendous amounts of impact energy and protect him from bodily injury. The occupant would be spared injury unless his passenger space became extensively crushed. But for some unexplained reason the teachings of physics have never been understood or accepted by the motorist—so, rather than "strap on" the vehicle and take advantage of its protective armor in a crash, the motorist watches the vehicle crash relatively slowly to a stop and then dashes himself violently to pieces against its interior! This makes no sense at all, but it is still standard practice after 50 years of automotive accident history.

The forces involved in a crash are directly proportional to the deceleration rates involved. These crash forces may cause direct injury, as in the typical example given above, or they may release other forces having high injury potentials. It has been observed in the cases studied that crash forces have a direct influence on the injury potential of the following factors:

1. Seat failures;
2. Door failures;
3. Interior surfaces and protuberances.

In some cases these factors may be the sole cause of injury; while in others they may serve to increase or amplify injuries even to the point of causing death.

*Seat Failures.* The average automobile front seat weighs, roughly, 100 pounds. In a 10G impact it is pulling on the adjusting track and mounting bolts with a force of 1000 pounds. If the impact reached 20Gs, the force would be a ton. From the frequency (see Table I) with which one finds seat failures in auto crashes, it is evident that the attaching members (adjusting track and mounting bolts) are incapable in many cases of withstanding the impact loads developed during a major crash. On impact the seats are torn loose and help to slap the occupants forward against dashes and windshields. Some cars have weaker supports than others. In many cases it has been found that all the mounting bolts were not in use. This sometimes results when seat covers are installed. When the seats are replaced workmen neglect to re-attach the seats with all the original mounting bolts. In other instances it has been found that seat assembly bolts are missing with the result that seats fly apart

Table I.

SUMMARY OF OBSERVATIONS.[1]

*Injuries and Deaths in 209 Collisions.*

| | Seat Failure[2] | Door Failure[3] | Both Seat & Door Failure | Interior Protrub. | Uncertain[4] | Totals |
|---|---|---|---|---|---|---|
| Injuries Plus Fatalities.. | 41 | 56 | 13 | 27 | 94 | 231 |
| Fatalities .............. | 28 | 32 | 8 | 9 | 20 | 97 |
| Injuries ................ | 13 | 24 | 5 | 18 | 74 | 134 |
| Cases in which Safety Belts would have given protection ............ | ?[5] | 56 | ?[5] | 12[6] | 69[6] | 137 |

1. These data are given only as qualitative findings. They have no statistical implications. The cases studied involve a certain amount of "selectivity," i.e., they are not run-of-the-mill cases from one area over a certain period of time. Rather, they are major collisions which were submitted for special investigation. To develop data of statistical value in such a study, a minimum of probably 10,000 injury collisions should be investigated. A study of this magnitude is beyond the capabilities of a single investigator.
2. Seat failures are those in which seat structures were damaged to such an extent that they contributed to the injury or death.
3. Door failure cases are those in which occupants were injured or killed by being thrown through a vehicle door.
4. Uncertain cases are those in which injury or death could not be related to seat or door failures, or to interior protruberances. These are the cases in which occupants simply collided with the normal interior surfaces, i.e., dashes, windshields, doors, etc.
5. Safety belts might have given protection in many of these cases if the seats had not failed. Belts properly stressed might also have prevented seat failures in some instances by holding both occupants and seats.
6. These figures are rough estimates. Under these headings the force patterns were complex, and it was apparent that some injury would have resulted even if belts had been used.

during impact.

No data is available as to how many Gs the seats in the various cars on the market will withstand, but from the number of seat failures which occur, it is evident that many cars have very low seat security.

The rear seat cushions are also very insecurely attached in most cars. They have frequently caused extensive injury. A 25 pound cushion in a 10G crash may hit a front seat occupant in the back of the head with a force of 250 pounds. The evidence indicates that seat failure problems have been largely ignored by automobile manufacturers, and yet they are intimately related to injuries and deaths in crashes.

Figure 1 shows a seat failure case. This is not a unique example; it is typical of thousands. The car is a 1949 model. One person was killed and three survived. The impact was head-on. No direct impacts were sustained by the seats or interior of the car, yet the interior destruction is extensive. This is failure "par contrecoup," that is, the car is struck at one point but falls apart at another point. The G intensity of the impact, of course, cannot be determined. Whatever it may have been, it is quite significant that three persons survived; yet the seats failed

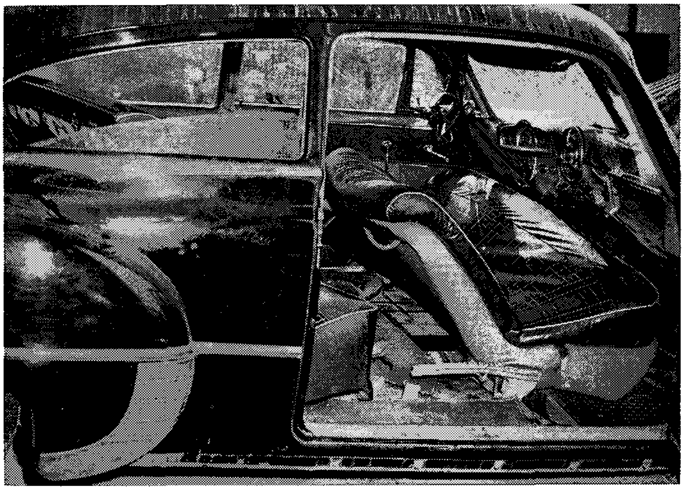

*Figure 1.*
Typical Seat Failure

miserably. Is it not reasonable that we should expect seat structures to endure greater impact loads than fragile humans?

*Door Failures.* During a crash it is not uncommon for car bodies to be distorted and sprung. When this happens one or more doors may become unlocked and fly open. If the car is in a partial spin at this time, driver or passengers may be thrown out. Again, accurate statistics are not available, but it is estimated that almost as many people are injured and killed in this manner as are injured or killed inside their cars. (see Table I.)

Centrifugal forces are responsible for occupants being thrown against and through car doors. These forces may also be rated in G units. An average occupant weighing 150 pounds has a horizontal pull on his body of roughly 50 pounds when a car makes a 20 foot radius turn at 10 miles per hour. This is sufficient to cause him to "lose his seat," especially if slippery seat covers are used. The same occupant will have a force of 840 pounds pulling him out of position when a crash causes a turning radius of 5 feet at 20 miles per hour. This is equivalent to approximately 5.5Gs. As the speed increases and the turning radius decreases, the forces and G units reach tremendous values. This, then, is the basic reason why such large numbers of car occupants are injured and killed outside of the cars in which they were riding.

Figure 2 shows a typical door failure case. Frequently there is nothing spectacular about these cases from a photographic standpoint. In the case shown, the car was struck at the right front side. Speeds of

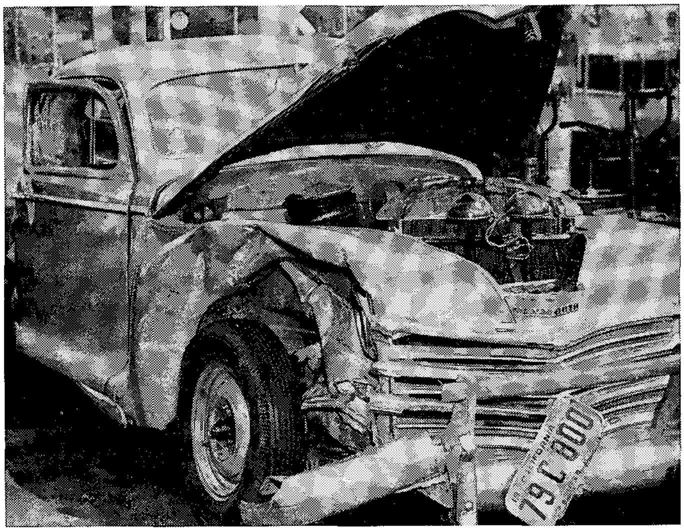

*Figure 2.*
Typical Door Failure

both cars were in the vicinity of 20 miles per hour. The spin produced forces of sufficient intensity to project the occupant in the right front seat through the door and onto the pavement. Death resulted from a skull fracture.

It is perfectly clear that if injuries and deaths are to be prevented from this cause the problem of door failure must be dealt with in some fashion.

*Interior Surfaces and Protuberances.* The various knobs, clocks, instruments, handles, mirrors, and random gadgets in the interiors of cars also cause serious injuries in crashes. Several manufacturers have adopted recessed knobs and controls, but there is need for further improvement along these lines. The interiors of cars, and in particular the instrument panels, must be designed so as to have the best possible surfaces for crash conditions. Research on this subject has been carried on at Cornell Aeronautical Laboratory.[2]

## CAN INJURY AND DEATH CAUSES BE REDUCED OR ELIMINATED?

There is little doubt that engineering improvements can be made which will reduce injury and death causes. Seats and seat cushions can be stressed to withstand high G values, both horizontally and vertically. This is especially true in automobiles (as compared with aircraft) where

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[2] See "Head Impact Investigation Report," 22 Dec. 1948, Cornell Aeronautical Laboratory, Inc.

weight is not an important factor. Eliminating the cost and weight of present day unnecesssary ornamentation on cars would substantially off-set the increases resulting from true safety improvements. Present day folding seats, which are dangerous in collisions, could be designed in such a fashion that they would lock rigidly in position when the car doors are closed. Door fastenings could be designed which would reduce the great hazard of door failures. Interior protuberances can be materially reduced, and instrument panels can be made which will absorb appreciable quantities of impact energy. Manufacturers should bear in mind that sponge rubber crash pads (mounted on instrument panels) are of little real value. Sponge rubber is an energy *storing* material. What is needed is an energy *absorbing* material. To simply cover the dash with some type of fabric is of even less value—it has substantially no energy absorbing ability.

One may ask: If these improvements can be made, why is it that the manufacturers don't get to work on them? The answer amounts to a stalemate. The manufacturers have not made the improvements because there is no public demand. And there is no public demand simply because the public does not know what to demand in the way of safety. The time may come, however, when a potential buyer will ask of a car salesman, "How many Gs will these seats withstand?" Few salesmen, if any, could answer such a question at the present time—yet the answer is more important to the customer than such things as gasoline consumption. Seat strength can be a matter of life or death—gasoline consumption pertains only to the pocket book!

*Safety Belts.* It has been pointed out that the basic cause of injury in a collision is the development of a relative velocity between car and occupants. It is perfectly evident that there is really only one good method of preventing these velocities. It is both inexpensive and simple. This method is to attach the occupants to the car seats so that velocity differences are prevented. In other words, the occupants "strap on" the car as they would a suit of protective armor. Safety belts *must* be used in cars if injuries and deaths are to be drastically reduced. The automobile manufacturers and safety organizations are, in fact, negligent in not admitting this truth to the motoring public. It is much more vital that safety belts be used in cars than in modern aircraft.

Safety belts are of fundamental importance in reducing injury and death causes for the following reasons:

1. Their use reduces the hazard of being catapulted against dash and windshield.

2. They will prevent an occupant from being thrown through an open or weakened door in spin type accidents.
3. They will make it possible, in many instances, for the driver to retain control of the car during and following a collision.

With reference to the first reason for their use, it is pointed out that a safety belt does not give maximum protection in head-on collisions, although it does give *increased* protection. Violent forward decelerations in this type of collision will cause the body to pivot forward at the hips. The chest will then collide with the steering wheel or the head of a passenger may strike forward structures. The latter is unlikely with small persons or with children. The belt does restrain the body mass to such an extent that impact energies to the body will be reduced. This will enable survival in many collisions which otherwise might produce fatal injuries.

With reference to the second reason, it is probable that this may be the most important element in using a seat belt. A very large percentage of collisions involve spins or partial spins, and the belt gives a very high degree of protection in these cases. At least until the door failure problem has been solved, it is extremely important to use belts so as not to be thrown out of a car.

The third reason is also of fundamental importance. Many crashes are made more serious because the driver has lost all control of his car. It is very difficult to use the steering wheel as a means of counteracting crash forces while at the same time using it to direct the car to safety. The brakes cannot be used effectively if the driver has been thrown to some grotesque position on the floor of the car. The safety belt keeps him where he is most needed in an emergency—where he can steer, brake, and even turn off the ignition. The advent of slippery seat covers has magnified the effect of forces which tend to pull a driver away from his proper position. Numerous accidents have been caused by the driver losing control because he "lost his seat."

The tragic consequences of loss of control came to the writer's attention in a recent passenger bus accident. The driver lost control as a result of a minor collision. Eight persons were killed and 22 seriously injured after the bus went out of control. A single safety belt could have prevented this tragedy! How much evidence is necessary to prove the urgent need for loss of control protection? It should be a basic minimum requirement for all vehicles on the highways.

The arguments against the use of safety belts are numerous but ill-considered. A few of the common arguments will be discussed briefly.

1. The time required to fasten and unfasten the belt makes them a nuisance.
   *It requires 10 to 15 seconds to fasten the belt and not over one second to get out of the belt using one hand.*
2. The fire hazard. It is argued that occupants would be endangered if the car took fire while they were strapped in.
   *If belts are used they have a good chance of being conscious after the crash and can help themselves out. If belts are not used they may be unconscious and unable to help themselves out of the car.*
3. When a crash occurs it is argued that occupants may be injured by the belts.
   *This may be true, but they would be injured more seriously without belts.*
4. Belts would be good for children passengers but not for adults.
   *There is no sensible basis for such a contention.*
5. Belts, when not in use, make the interior of the car "messy."
   *This is true, but it can be corrected by clever design. Retractable belts, disappearing in slots when not in use, could be developed.*
6. Safety belts would make drivers more reckless.
   *This is very unlikely. One might also claim that drivers have been more reckless since the advent of safety glass.*
7. Safety belts are uncomfortable.
   *This is not true. It is not necessary to have belts pulled up tightly around the body. Cornell studies*[3] *have indicated that roughly four inches of hip movement gives the best protection. Even a very loose belt gives some protection against being thrown from the car, or losing control.*
8. Safety belts are only desirable at high speeds.
   *This is not true. Many fatalities result from occupants being thrown from a car at speeds as low as 15 to 20 miles per hour.*

In spite of the great benefits of the safety belt, it must be reiterated that they will not prevent all injury. The work at Cornell[3] and at Grace Hospital, Detroit, under Drs. Gurdjian, Webster, and Lissner has shown that on the average 50 foot pounds of energy is required to produce a skull fracture when the head strikes a smooth flat surface. When the object struck is small, like a radio knob, a skull fracture may result at impact energies as low as four or five foot pounds. Even though a safety belt is in use the body, especially of a tall person, may pivot forward in a major head-on crash, causing the head to strike the instrument panel with impact energies much greater than 50 foot pounds. Therefore, one cannot escape the fact that maximum protection in all collisions cannot be obtained with the safety belt alone. Maximum protection demands the use of shoulder harness and crash helmets in addition to belts. These additional safety devices are developed and available, but there is little hope for their general acceptance. To the average motorist the inconvenience and public embarrassment of such protection

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[3] See "Kinematic Behavior of the Human Body During Crash Deceleration" by E. R. Dye, Cornell Aeronautical Laboratory, 4 Jan. 1950.

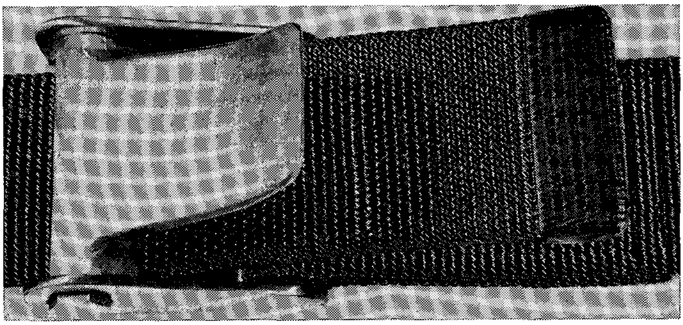

*Figure 3.*
Standard Aircraft Buckle
(Courtesy of Parachute Corp. of America, Los Angeles, Calif.)

would be worse than death. As a matter of fact, even the tremendously increased protection of a safety belt holds little interest for a motoring public which is reconciled to sudden and unnecessary death in traffic.

It is strange, indeed, that safety belts were not used on cars from the very beginning. If brakes were considered logical mechanisms for cars, why was it that no one considered it advisable that they also be made available to the car occupants? Why stop the car if the occupants can't stop? The missing link in the picture is the safety belt. The safety belt makes the brakes available to the bodies of the occupants—and in a crash the belts stop the occupants before they collide violently with rigid car structures.

*Types of Safety Belts.* Safety belts for use in motor vehicles should meet the same specifications as those used in aircraft. These specifications have already been standardized.[4] The two inch webbing of either nylon or cotton should withstand a minimum load in tension of 1500 pounds. The complete belt should hold a 3000 pound load around a block simulating the human body. The quick-release buckle should provide for full release with a pull not exceeding 45 pounds when the belt is under the weight load of the passenger.

Three types of buckles, all designed for aircraft use, are suitable for motor vehicle service. Figure 3 shows the most common type of aircraft buckle. Since thousands of air travelers are familiar with the use of this buckle, no difficulties would arise in its application to ground vehicles. Its operation is very simple and practically fool-proof. Figure 4 shows another type of buckle which is especially suited to automotive service. This buckle has the distinct advantage of permitting the belt

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[4] See CAA Technical Standard Order, TSO-C22a, Nov. 15, 1950.

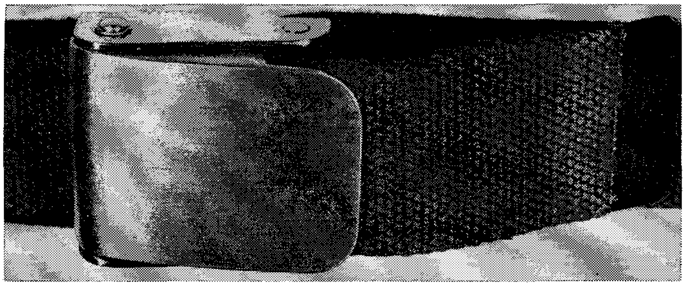

*Figure 4.*
New Type Aircraft Buckle
(Courtesy of Parachute Corp. of America.)

to be tightened by one hand, thereby allowing the driver to keep one hand on the steering wheel at all times. Both buckles enable quick release with one hand. Belts using these buckles are rated at 10Gs, but they will withstand impact loads up to 15Gs in some cases.

Figure 5 shows a heavy duty 40G buckle used in military aircraft. It would not be desirable for passenger car service but might be appropriate for use as a driver's belt in large passenger buses and heavy freight equipment. Loss of control of such heavy equipment presents a much greater hazard than in the case of light passenger vehicles, and a greater margin of safety may be desirable.

The mounting of the belts in vehicles is also of great importance. In no instance should they be attached directly to vehicle seats unless it has been determined that the seats themselves are properly stressed for impact loads. Fortunately, in the lighter passenger cars where the seats are not stressed for high loads, it is usually possible to lace the belts between the junction of the back and lower seat cushion. The end fittings may then be attached directly to forged eye-bolts mounted through the floor and reinforced on the lower side with large (2 inch diameter) washers. It is also desirable that these eye-bolts be inspected by Magnaflux before use in order to detect any latent defects.

The belts may be mounted so that the buckle can be operated with either the right or left hand. The buckles may be obtained in chromium plate to prevent any damage to clothing. Numerous webbing colors are also available.

It should be pointed out that single passenger belts afford the greatest protection. It is possible, however, to provide reasonable back seat protection in sedans by means of a three-passenger belt. In all instances, however, the driver should use a single passenger belt in order to prevent loss of control of the vehicle.

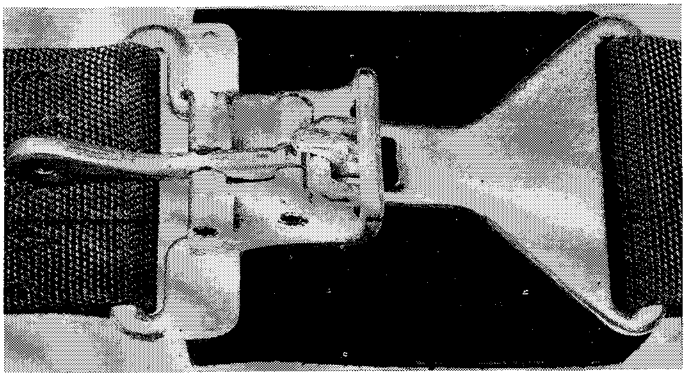

*Figure 5.*
Heavy Duty Military Buckle
(Courtesy of Parachute Corp. of America.)

Belts should be mounted downward from the horizontal at an angle of roughly 60 degrees. They should not be mounted horizontally so as to restrain the waist or chest. It must be borne in mind that crash forces have both vertical and horizontal components. The 60 degree mounting affords the best compromise. Furthermore, anatomical considerations indicate that injuries might result from purely horizontal restraint at the waist or chest. These statements do not apply to the use of shoulder harness where the entire torso is restrained.

## INDIRECT INJURY CAUSES

Along with observations relative to causes of injuries in crashes, it has also been noted that certain other design features of cars are indirect causes of injury. In certain types of crashes it has been found that bumper guards, protruding bumpers, and protruding fenders frequently function in such a manner as to make major crashes out of minor ones. The reason is that these exterior protuberances become caught on another car or fixed object, resulting in the production of a spin or partial spin. In an airplane definite procedures can be followed to recover from a spin. In an automobile no spin recovery is possible. Nature simply takes its course—and the driver can only hope the energy of the spin will be dissipated before he crashes over a curbing or into another car.

The exteriors of cars should be smooth and free of protrusions. When cars collide with other cars or fixed objects at not too high speeds, they should be able to slip free rather than become entangled with each other.

## AUTO-PEDESTRIAN ACCIDENTS

It has long been recognized by accident investigators that exterior protuberances, such as door handles, ventilator scoops, and radiator ornaments, cause serious injuries to pedestrians. In spite of these common observations, nothing has been done to eliminate such hazards. In fact, radiator ornaments are more deadly on the newer cars than on those of the past. There have been many cases in which a pedestrian might have survived impact with a car if one of these exterior protuberances had not produced a fatal injury.

## CAN LEGISLATION BE DEVELOPED TO PROTECT THE MOTORING PUBLIC AGAINST INJURY CAUSES?

A critical appraisal of the legislative aspects of these matters is, of course, beyond the province of the writer. It is evident that legislative efforts will not be forthcoming until the true facts of collision injury are well understood. There are good reasons to believe that legislation can and should be ultimately formulated. Just as the Pure Food and Drug Laws safeguard the public against contaminated foods and harmful drugs, there could be laws which establish safe practices relative to injury prevention in the design and operation of motor vehicles. In fact, to some degree we now have such laws. Most Vehicle Codes have sections dealing with brake requirements, headlight specifications, load limits, and numerous other items. The purpose of these sections is to protect the motoring public. It is likewise reasonable that Vehicle Codes should require certain specified seat strengths, adequate door fastenings, freedom from dangerous exterior and interior protuberances—and perhaps even the mandatory use of safety belts in certain types of vehicles. It has been argued that such legislation would not be enforceable. This argument indicates that the facts of collision injury have been overshadowed by the futile efforts to put an end to all accidents by increasingly complex legislation. Accidents are inevitable as long as metals fail from fatigue and vehicles are operated by human beings. They cannot be prohibited by law. Collision injuries, however, can be effectively curtailed by proper traffic legislation.

## CONCLUSION

It is imperative that careful consideration be given to the elimination of injury and death causes if we expect to achieve any substantial safety improvement on the highways. It is clear that selective enforcement, driver education, and highway engineering cannot alone accomplish the desired results. This new study of injury and death causes should be the subject of well planned research programs. Experimental crash studies should be made and new designs should take into account those factors which will tend to minimize injuries and deaths. Sales and advertising programs should be at least partially predicated upon true safety improvements—rather than on trivialities amplified by high powered language. The desirability of using safety belts in cars should not be kept a secret from the public. In all these things the automotive manufacturers must take the lead—they must not expect these improvements to come only as a response to public demand or poorly conceived legislation.