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ARMY MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

REPORT NO. 93

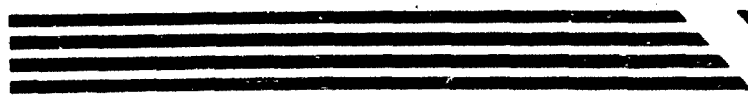
1 August 1952

A SURVEY OF TANK CREW PROBLEMS*

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*Subtask under Human Engineering Studies, AMRL Project No. 6-95-20-001.



MEDICAL RESEARCH AND DEVELOPMENT BOARD
OFFICE OF THE SURGEON GENERAL
DEPARTMENT OF THE ARMY

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A SURVEY OF TANK CREW PROBLEMS*

from

Psychology Department
ARMY MEDICAL RESEARCH LABORATORY
FORT KNOX, KENTUCKY
1 August 1952

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Report No. 93
Project No. 6-95-20-001
MEDEA

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ABSTRACT

A SURVEY OF TANK CREW PROBLEMS

OBJECT

To point up problems of the tank crew which may be alleviated by human engineering research.

RESULTS

Interrogation of experienced tank crewmen revealed certain problems as they applied most directly to the commander, gunner, loader, and crew in general. The most frequently reported problems for each job were:

Commander - problems of communication

Gunner - problems of space allotment

Loader - problems of position

Driver - problems arising from interference
with the field of vision

All tankers - problems of individual equipment
(helmets, field jackets, ponchos, etc.)

CONCLUSIONS

Many problems of interest for human engineering were uncovered by the survey.

RECOMMENDATION

The survey should be repeated with carefully selected samples of tank crewmen who are familiar with the later models of tanks. Then specific problems of the tank crew as well as their order of importance could be determined with indications for remedial research and design.

Submitted by:

Psychology Department

Written by Edward E. Johnson, 1st Lt., MSC

from material collected by

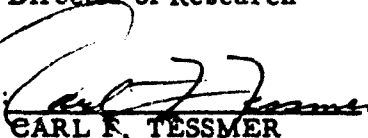
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A SURVEY OF TANK CREW PROBLEMS

I. INTRODUCTION

Engineers design equipment consistent with the highest standards of mechanical efficiency. Yet it would appear reasonable to go to the user for a critical evaluation of the efficiency of the machine under normal human operation since it is he who ultimately must operate and depend upon it. Human engineering is concerned with designing the machine to fit the man with his limitations and capabilities; thus any technique which points up problems of the user is its concern. This report attempts to throw some light upon problems of the tank crew - problems which might well be alleviated by proper human engineering design.

II. METHODS

The subjects questioned for this study were 894 persons attending the Armored School, Fort Knox, Kentucky, during the months of November and December, 1951. They were oriented as to the kinds of problems in which the human engineer is interested, and were asked to write down in detail some incident which they as tank crewmen witnessed or participated in and which involved harm to someone, damage to equipment, or loss of tactical advantage. The interviewer then cited as an example an incident reported in a similar Air Force study. Those subjects who were unable to think of an incident during the first five minutes were instructed to write down instead some suggestions for improving the tank crew's equipment. It is to be noted that this approach is very similar to the critical incidents technique of Fitts and Jones (1, 2).

The total number of incidents reported by the subjects was 894, of which 623 (69.7%) were concerned with problems of interest for human engineering. The range of the other 271 papers was very wide, varying from complaints about racial discrimination to suggestions for improving heating conditions in the barracks. Five hundred and twenty-one of the incidents of interest for human engineering were concerned with the tank itself. The others were concerned with diverse problems such as mechanical failures and isolated cases of complaints about the operation of related equipment. It was decided to limit this analysis to problems of the tank crew. These incidents were subdivided as they applied most directly to the tank commander, gunner, loader, or driver. A final category was concerned with problems common to the entire crew.

Two limitations of the present study must be noted. First, most of the incidents reported here were concerned with the now obsolete

M4 tank. Yet it appears reasonable that recognized violations of basic human engineering design principles that occurred in a now outmoded tank can point to items which should be considered for improvement in present tank design. Second, an important difficulty was faced in attempting to assign the right amount of importance to clusters of incidents in terms of their frequency. The manner of investigation provided no way of equating the sampling of jobs done by the tank crew. Thus a heavy cluster of incidents relating to the driver's field of vision might mean that that area is in critical need of remedial research; on the other hand, a high frequency of incidents here might simply be a function of a sample bias resulting from a disproportionately large number of drivers in the sample. These two limitations must be borne in mind.

III. RESULTS

The findings of the present study are summarized in Tables 1 to 5, with the problems of the commander, gunner, loader, driver, and crew in general presented separately.

TABLE 1*

PROBLEMS OF THE COMMANDER

	No.
Problems arising from interference with the field of vision	
Error in sensing fire when back blast hits commander in face	7
Inadequate field of vision with commander's periscope	1
Visual contact broken by metal ring above vision blocks	1
Problems involving communications equipment	
Both hands required to use intercom system	16
Loss of communication when cordage pulls loose from plug jacks	2
Problems involving gunnery	
Awkward position of 50 cal machine gun	3
Accidental injury arising out of gun recoil	4
Accidental wedging of foot between turret and traversing basket	2
Problems of space allotment	
Commander in cramped position	9
Total	45

*See appendices 1 - 5 for representative examples of the types of problems listed in Tables 1 - 5.

TABLE 2

PROBLEMS OF THE GUNNER

	No.
Problems of instrument display	
Confusion of gun sight lead lines when tracking	1
Difficulty in interpolating gun fire settings with M-71 telescopic sights	1
Difficulty in reading reticle designation of 76 mm gun	1
Awkward position of azimuth indicator	4
Problems arising from interference with the field of vision	
Lack of vision from gunner's seat	2
Improper positioning of gunner's periscope	2
Problems of communication	
Accidental firing arising out of inadequate signaling between gunner and loader	4
Error arising from faulty BC-604 transmission	1
Problems involving controls	
Accidental firing arising from foot operation of firing mechanism	4
Inadequate leverage due to position of traversing lock	3
Accidental wedging of the foot while traversing turret	5
Problems of space allotment	
Elevating handwheel too near breech ring of 90 mm gun	2
Gunner in cramped position	12
Total	<u>42</u>

TABLE 3

PROBLEMS OF THE LOADER

	No.
Problems of communication	
Error arising out of inadequate signaling between loader and gunner	4
Problems of position	
Awkward position of ready racks	6
Problems of space allotment	
Inadequate space for ejected brass	3
Loader in cramped position	3
Total	<u>16</u>

TABLE 4

PROBLEMS OF THE DRIVER*

	No.
Problems of instrument display	
Awkward location of instrument panel	6
Difficulty in reading instruments after looking through periscope	2
Error arising from confusion of tachometer and speedometer	1
Problems arising from interference with the field of vision	
Inadequate field of view with driver's periscope	14
Decreased visibility due to dust	12
Problems of communication	
Accidents arising from inadequate communication between driver and commander	2
Accidents arising out of inadequate signaling under blackout conditions	4
Problems involving controls	
Difficulty in depressing clutch pedals while shifting gears	7
Inadequate leverage of steering laterals	5
Magneto switch in awkward position	3
Accelerator and brake pedals in awkward positions	5
Error in use of wobblestick	2
Problems of space allotment	
Gear shift position too close to drive shaft housing	3
Not enough distance between sponson and lateral	1
Driver in cramped position	4
Total	<u>71</u>

*It is to be noted that many of the problems reported here applied to the now obsolete M4 tank and have been eradicated or at least lessened in the more recent tanks.

TABLE 5

PROBLEMS COMMON TO TANK CREW
IN GENERAL*

	No.
Problems arising from interference with the field of vision	
Field of view decreased during "buttoned up" operations	4
Difficulty in using telescope and periscope when wearing glasses or goggles	16
Problems involving communications equipment	
Inadequate design of earphones causing discomfort	20
Inadequate design of lip microphones causing discomfort	15
Inadequate design of headsets causing discomfort	20
Excessive tank noise	1
Problems of tank design	
Accidents arising out of unsafe hatch design	59
Accidents occurring while mounting the tank	27
Problems of the tank environment	
Inadequate ventilation	5
Inadequate heating	9
Tank parts jarred loose by vibration	1
Problems of individual equipment	
Design of tanker's helmet inefficient	22
Design of one-piece fatigue uniform inconvenient	4
M1943 field jacket not warm enough	44
Tanker's uniform too bulky	62
Inadequate design of combat boots	18
Inadequate design of ponchos	20
Total	347

*The problems reported here are separate from those included in the preceding tables.

IV. DISCUSSION

As has been stated above, these data were not collected specifically on tanks, although they were collected from tank crewmen. This is a limitation which conceivably is reflected in the high frequency of single cases of certain incidents. For example, there was only one complaint of excessive tank noise, one report of confusion of gun sight lead when tracking, and one complaint of inadequate field of vision with the commander's periscope. It may well be that a survey limited to problems of the tank operation would reveal a much greater incidence of these types of problems.

Another limitation, which may be inherent in the critical incidents technique itself, is that to ask a man who has used equipment for a long time to state its shortcomings may be fruitless, since frequently he has adjusted to the shortcomings and no longer recognizes them as such. Thus some important problems might well go unemphasized in this type of survey.

A. Problems of the Commander

In spite of sampling limitations, certain kinds of problems were reported frequently enough to warrant closer inspection of the data. For example, 16 out of a total of 18 incidents involving communications problems of the tank commander occurred because both hands were required to use the intercom system. The following statement is a direct quote from one of the incidents and was a typical comment:

"During the performance of duties as a tank commander I have found difficult, in operating the radio while moving cross country. It is necessary when using the hand microphone to use two hands, one to push the push-to-talk button on the mike, and another to change the control box switch from interphone to radio."

Design of an intercom system that requires less direct manipulation would seem to be indicated. Inadequate space in the commander's area, and error in sensing fire when the back blast of the gun hit him in the face were the next two tank commander problems, in order of frequency.

B. Problems of the Gunner

One-third of the incidents relating to the gunner arose out of problems of space allotment and 12 of 14 of these incidents were

directly concerned with the cramped position of the driver. A typical comment follows:

"There is an extreme shortage of room for the right leg in the M4 series tank for the gunner. The boxes under the seat might be located differently, enabling the foot to be tucked under the seat. As it stands, your leg is jammed between the manual traverse mechanism and the boxes."

As is indicated in this example, the space problem for gunners might well be one of arrangement, not strictly one of area. If it is assumed that the relatively high incidence of space complaints was not an artifact of the sampling limitations, it would appear useful to determine that arrangement of controls and equipment which would make for least cramping of the individual operating in the gunner's area.

Noting the limitations of the sample, one may speculate as to what the frequency of some of the other gunner's problems might mean. Four incidents involving errors in interpreting the azimuth indicator occurred because of the necessity of assuming an awkward position in order to read it. The 4 cases of accidental firing arising from foot operation of the firing mechanism involved buttons that were too close together and unmarked. This is a design problem that can be remedied by application of human engineering principles. The 5 cases of accidental wedging of the foot while traversing the turret would seem to indicate the need for better spacing and the possible design of a protective foot rest.

C. Problems of the Loader

The loader's problems were almost evenly distributed among problems of communication, position, and space allotment. Error arising out of inadequate signaling between gunner and loader was reported 4 times and inadequate space for ejected brass and for the loader was reported 6 times. A typical comment follows:

"Inasmuch as the ready rack is below and at right angle of the gun, it is necessary to pull the round out and with a turning motion align it with the tube, then insert it in the chamber. I have tried various ways of handling the rounds and the only way it can be handled smoothly and quickly is by facing the breech, which is dangerous and which we are instructed not to do."

It would appear profitable for the human engineer to be concerned with the design and placement of the ready rack and with similar problems involving conflicting motion.

D. Problems of the Driver

Forty-eight of the 71 incidents relating to the driver involved interference with the field of vision and problems of control. Inadequate field of view with the driver's periscope and decreased visibility due to dust accounted for 26 of these. The incidents involving controls were varied, including difficulty in depressing clutch levers while shifting gears, inadequate leverage of steering laterals, awkward positioning of the magneto switch, poor space relationships between the accelerator and brake pedals, and inadequate design of the wobblestick (M46). *

A frequent complaint of the instrument display was that the driver often made errors in interpreting instruments because he had to move awkwardly while steering. This complaint would seem to point to the important principle that physical location of controls often do not allow for most efficient sequence in their operation.

E. Problems Common to Tank Crew in General

Three hundred and forty-seven of the 521 incidents were concerned with problems common to all tankers. Even in view of the limitations of the present sample, the preponderance of incidents in this category must be noted. It would seem that the human engineer must be immediately concerned with those problems that occur with all tankers, as against the more individual ones. The problems of tankers' individual equipment were the most numerous in this category. The tanker's uniform was singled out for the most complaints, 62 reports describing it as too bulky. The M1943 field jacket was described as not warm enough 44 times. The problem here is one of decreasing the bulk of the uniform and at the same time maintaining or increasing its warmth. Inadequate design of tanker's helmets, one-piece uniforms, combat boots, and ponchos was included among the problems of individual equipment. In his efforts to design the machine to fit the man, the designer must not overlook the fact that conditions distinct from the machine might affect significantly the individual's ability to use it effectively. The problems of individual equipment would seem to be of importance on that account.

*Some of the problems reported here have been minimized by recent modifications in tank design.

Next in frequency to the problems of individual equipment were general problems of tank design. Accidents arising out of unsafe hatch design and unsafe conditions for mounting the tank accounted for all incidents in this category. Changes in the design of future tanks which take into account these poor features would seem to be indicated.

Fifty-four of the 55 incidents resulting from difficulty of communication were ascribed to discomfort arising from inadequate design of earphone, lip microphone, and headset. A typical complaint follows:

"From past experience I've found that the standard T-45 lip mike used in tanks after being worn for an hour or so starts to hurt the ears. The small wire type fasteners that fit around the ear are inclined to cut in and hurt."

Changes in the design of earphone, lip microphone, and headsets such that they will cause less or no discomfort to the wearer would seem to be indicated. It is to be noted that several agencies now are doing research to improve individual communications equipment.

"Buttoned up" operations and the wearing of glasses or goggles when using the telescope or periscope are difficulties which interfere with the field of vision of all tankers. Problems of the tank environment included difficulties arising from inadequate ventilation, poor heating, and the jarring of tank parts by vibration. Any attempt to apply human engineering principles to tank design must be concerned with these problems.

V. CONCLUSIONS

Since the sample has many limitations, as has been pointed out, no specific conclusions concerning human engineering problems can be made. However, the critical incidents technique utilized in this study has pointed up many questions of importance for human engineering, equipment and design.

VI. SUMMARY

Five hundred and twenty-one incidents limited to problems of the tank crew were separated and analyzed out of a total of 623 concerned with general problems of human engineering. These incidents were categorized as they applied to the commander, gunner,

loader, driver, and crew in general. The findings would seem to indicate that the critical incidents technique is a useful, although limited, device for discovering human engineering problems.

VII. BIBLIOGRAPHY

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APPENDIX

SELECTED QUOTATIONS FROM THE SURVEY WHICH ILLUSTRATE THE PROBLEMS

PROBLEMS OF THE COMMANDER

1. When operating the tank radio it is necessary to hold the spring-loaded switch on the BC606 control with one hand while holding the microphone to the lips with the button depressed with the other hand. While going cross-country in rough terrain, my tank was taken under fire by enemy troops. In attempting to radio to other tanks in my platoon, I was unable to hold on securely and operate the radio, too. The tank came off a rice paddy and I was severely shaken up and fell to the turret floor.

2. I was acting as a tank commander on an M-4 tank with a 76-mm gun. We were firing on the range in October 1951. Each time the gun was fired the back blast not only carried a great amount of concussion back into my face, but also hot gases. The most objectionable feature of the back blast was the small particles of metal rotating band that were blown back with great force which lodged metal particles in both my face and hands. Even though binoculars were used, one particle lodged in my nose about 1/4 inch from my eye. Another officer actually had a particle blown into his eye and was hospitalized for about two months. This officer was sent to specialists who were unable to remove the particle and it may eventually lead to the loss of his eye. The combination of the flash, concussion, and flying metal from the rotating band make it difficult for the tank commander to accurately spot the hit of the round in order to make adjustments in the fire on the target. If goggles are used, it makes it almost impossible to use the binoculars which are necessary.

3. When firing, as tank commander, the 76 or 90-mm tank, I always have a lot of trouble with the back blast hitting me in the face and spoiling my sensing. The vision block in the turret ring is not large enough to get a good forward view. This is on the M4⁵ and the M46⁵.

4. This incident occurred on a tank combat course at Fort Hood. Everyone was buttoned up except the tank commander. On this run, it was his job to spot targets and either fire on them with his 50-cal. or give the gunner the firing orders over the interphone system. As he was firing on a target with the 50-cal., another

target appeared that required the use of the 76-mm gun. The tank commander had to stop firing the machine gun in order to press the to-talk switch on his chest set so that he could communicate with the gunner. The machine gun had to go out of action temporarily because it can not be effectively fired with one hand. The loader couldn't take over because he had to be ready to do his loading job. Because the intercom system required the use of the hands, the fire power of the tank was considerably lessened for short period of time.

5. While a tank commander during a range problem, we were required to drive our M-24 tanks and fire all guns. The first thing to happen was that I lost communications with my driver. His shift lever had caught in the cordage and pulled the plug jacks from the control box. On the same problem, the loader, in turning around with the cordage on the wrong side of his body, pulled his plugs. The result was momentary confusion and loss of time. This same thing has happened with every member of my crew and with me time after time.

6. I have been in an M4E8 tank which mounted the 50-cal. machine gun on a pedestal mount at a time when the column in which I was riding was suddenly attacked by low-flying enemy aircraft. As tank commander, I found it impossible to take the plane under fire, due to the length of time required for the tank commander to crawl out of the turret, mount the back deck, and fire. Even if there were time, the tank commander would be placing himself in the most exposed position possible for the very doubtful advantage of firing a 50-cal. m. g. at a high-speed aircraft. I notice that new tanks, i. e., the M41, include the pedestal mount for the 50-cal., thus making the gun almost entirely useless.

7. About 2 December 1950 in Korea, tank commander of an M-4 tank, caught his foot between turret and traversing basket, crushing foot. Tank commander was standing in normal position on grenade box just to the rear of the tank gunner. His right foot was pointed out at a right angle which allowed his foot to be caught between the rotating turret and the hull. This is a frequent accident on the M-4 tank, most cases being less serious than the above, however, still painful.

8. On various occasions, I have noticed that, in my opinion, the tank commander's seat in the M-46 tank causes a slight degree of discomfort and irritation to the tank commander when traveling with the tube in the travel-lock position. If the seat is raised high

enough for the tank commander to observe properly, there is no room for his legs and knees due to the proximity of the rear of the turret and its various compartments. If the seat is on the down position and folded back, the tank commander cannot see due to the great depth of the fighting compartment. The various notches which regulate the height of the seat are of very little consequence with your turret reversed. The guard for the 90-mm gun prevents the tank commander from turning sideways to the right.

9. During a period of training a group of men in our own battalion on gunnery and actual firing of the 76-mm gun on the M-4 Tank, and also a period of firing on the 90-mm gun on the M-46, I found a lot of difficulty in having the men who were tank commanders use the Vane Sight. In practically all cases when the men were questioned on the use of the Vane Sight for proper deflection to get the gunner close to target in deflection, they came up with the same complaint, that the location of the sight made it difficult to use, especially when it was necessary to "button up". There was such a very restricted space there and an uncomfortable position you had to get into to use the sight to an advantage. So they merely looked at the tube and decided it was pointed close enough in the direction of the target without squirming down to a position where you could sight with the Vane Sight. But this did not give them the effectiveness that could be obtained if the sight could be used easily.

PROBLEMS OF THE GUNNER

1. Tank Range, Fort Knox, Summer Camp, Summer of 1950. A man's arm has just been broken, his nose is bleeding, and his mess kit, which was strapped to his side is now all bent in - Why? The gunner fired the gun and the loader wasn't ready or hadn't given up. Between the noise and confusion, gunner trying to pay attention to what he is doing and also listening to the Tank Commander's commands, he finds it hard to remember the loader, much less remember whether he has given up or not, to signify he is ready. This happens many times; because the loader's "up" is not a satisfactory signal.

2. It seems that because the bottom for the 76-mm gun and that of the 30-cal gun are so close together, the 76-mm was fired by mistake while the driver and boy did not have their heads in. I almost caused both of these to lose their hearing, along with endangering the life of the loader. If he had not been out of the way of the recoil, I don't think he would have liked it.

3. When tank commander uses his power-traverse control handle (on M-4 tank), it causes the gunner's power traverse control handle to exert a crushing force on the gunner's right knee. Perhaps this has happened to me because I have long legs (height 6'3"), and have difficulty in finding a position for my right knee while I am in the gunner's seat.

4. Azimuth indicator is in an awkward place on all tanks. It would increase the efficiency of the gunner in my estimation if the indicator was placed just beneath the sight and tilted toward the gunner like the speedometer on a car. It would save wear and tear on the instrument in this manner, also.

5. I saw a man squeeze his foot between a portion of the moving turret in the M-4 and the stationary portion of the hull. He was the gunner of an M-4A3 Medium Tank, and the turret was in power traverse. Unbeknown to this man, his foot protruded beyond the ring and when he traversed the turret, his foot was badly crushed between the turret ring and the hull support.

6. Turret traversing lock on M4A3E8 and several other tanks is located behind the gunner, making him twist around in seat and lose leverage because of awkward position when releasing lock. For cure of both above complaints, I suggest relocating traversing lock where it is easily visible and can be reached and unlocked with ease. Probably best position would be in front of gunner where he can pull directly back on lock thus, with maximum leverage.

7. This is not an instance of particular time, but the result of a series of experiences. The gunner's position on any tank is, naturally, cramped and full of hydraulic lines, wheels, gears, and dial boxes, all of which are metal and extremely uncomfortable to be bounced against. It has been my unhappy experience to find that even a gentle cross-country run in a tank can throw the knees and legs of the gunner against these various metal obstructions sufficiently hard to cause crippling bruises and cuts.

PROBLEMS OF THE LOADER

1. I was acting loader on the firing range at Fort Knox for M4A3E8 tanks. The type of tank has no bearing on the instance because the result would be the same in any of our present models. We had sent a round on-the-way and the breech was open awaiting a new round. Being the loader, I quickly got another round from the ready rack and placed it in the chamber and rammed it home.

The gunner had absent-mindedly, or accidentally, put his foot on the foot firing switch before I said, "Up". Therefore, the firing of the round was almost immediate and the recoil from the gun barely grazed my right arm. No injury was received, but a broken or shattered arm could have been the unlucky result.

2. During tank firing training in an M4A3E8, mounting a 76-mm gun, I found that if I observed all the safety rules for loading my legs would begin to cramp, due to the unnatural position, after 10-15 minutes. Since I am a normally proportioned individual of average size, I am sure others must have the same trouble, and for this reason, I believe the loader must be given more room in future tank design.

3. Loader's fighting area is too small in M-46 tank. The ready racks in the M-46 are located in a position that hampers the rapid loading of the gun. Anyone but a very small man with gorilla-like physique, is extremely uncomfortable.

4. At Camp Irwin, California, last August, while working in M46 tanks, I had my loader drop a round on the primer while taking it right out of the ready rack. It was hot and his hands were wet is the reason he couldn't hold it, but I think the main reason is the ready rack itself. The rim at the bottom makes you lift the shell straight up before you can get your hand on the base to handle it.

PROBLEMS OF THE DRIVER

1. When driving the M4A3 or M4A1 medium tank while buttoned up, once your eyes become accustomed to the light by looking through the periscope, it is extremely difficult to read any of the gauges on the instrument panel. Since it is necessary that you do glance at these gauges occasionally, and in order to do so you have to wait a few seconds for your eyes to become readjusted to the darkness, I believe that if a brighter instrument panel light were installed it would allow you to read the panel without those few seconds delay.

2. I suggest that improvements be made on the periscope in the M24 tank, as well as in other tanks. I believe that the periscope should have a larger picture opening so that while crossing hilly country, there wouldn't be so many blind spots while coming out of a deep ditch or going over the peak of a hill. At present, the periscope cannot be moved without taking a hand off of the steering laterals. If it could be moved, possibly with the head or by the inertia of the tank itself, I believe it would be a big help to safety and better maneuvering.

3. I suggest that they change the steering in the M4A3 tank, Because you need two hands to steer and you start up a grade, you have to shift gear and it's hard to steer the tank at the same time. There should be a way of steering the tank with one hand and shifting gears with the other.

4. When I was learning to drive an M4 tank, the motor would have a tendency to be sluggish. After a few moments of looking into the matter, I found that my knee had hit the magneto switch and had knocked it onto only one bank when the motor should be running on both banks. A person has a tendency to let their leg relax on the clutch pedal and a person's knee will always hit the magneto switch. This still happens to me all of the time, even though I try not to do so.

5. In my limited experience in taking turns now and then driving a tank (mainly M4A3E8), I have found it difficult at times to stop a tank in an emergency or slow it down in a hurry while going down a hill or over rough terrain. The difficulty is in not having a spot to plant your foot while driving, and to brace yourself to pull back on the steering laterals. In order to pull them back sufficiently while going down hill, I have had to stand up and brace myself against the front of the hatch and apply backward pressure to the laterals. This makes it extremely harder to have to be jumping up and down in that manner. Also, at times, I have conked myself on the chin or elsewhere rather hard if I hit a sudden bump or obstacle while in this position.

6. I am a tank commander of a M4A3E8 tank, and I am constantly having trouble with my driver's skinning their hands while shifting gears. When you try to shift from fourth into fifth gear, if you hold the lever as you should, your knuckles will strike the transmission housing as you place it in gear.

PROBLEMS COMMON TO TANKERS

1. On at least a dozen different occasions while on field problems with my platoon, I have found an excessive delay on the part of my men in reporting on enemy position which they have spotted, or a malfunction of their tank which has just been noticed, and such matters requiring immediate radio or inter-communications, for the simple reason that the men cannot be made to wear their lip microphone for periods in excess of one hour. They say that after that length of time, the microphones become so irritating that they have to take them off. I have found this to be especially true in hot weather when perspiring is excessive.

2. It is necessary for me to wear glasses all the time. I have a reasonably bad astigmatism. Without my glasses, it is difficult for me to make out the instruments and readings on the tanks. With the present type of goggles (full vision with rubber edges and plastic lens), it is impossible for me to wear my glasses under them. With the glasses under the goggles, the goggles don't fit tight to my face; they exert pressure on my nose over the glasses and other parts, which makes it painful and irritating to wear; if the occasion arises to remove the goggles quickly, the rubber lips inside and the flexibility of them (they collapse and catch the glasses) pull your glasses off with them.

3. For 12 months, I was a member of a tank battalion in Korea. One of the most bothersome pieces of equipment I used in the tank was the earphones. It was necessary to wear the earphones for long periods at a time - 6 to 15 hours each day. The small nipple inside the phone protruded into the ear, causing great discomfort after a few hours of operation. If the earphones had these nipples removed, reception was decreased considerably and the roar of tank engine made reception without the nipple protruding into the ear practically nil. Consequently, radio reception after a few hours of operation became increasingly poor because men would not keep their earphones on their heads. Tank or crash helmets, with earphones built in, did not help much because reception was about the same as if the nipples had been removed from the standard earphones.

4. During basic training, the company was firing the 75-mm tank gun at moving targets. Each man was to fire 5 rounds. After a few rounds, the tank was filled with fumes from the gun, and this state of affairs considerably interfered with the loader and the gunner's operations. The tank hatches were open and some of the fumes escaped this way; but in combat, this would not be an ideal method to get rid of the fumes.

5. The M4E8 tank hatch on the driver and bog compartment I believe is a hazardous implement. That is it is not securely enough latched and may be jarred loose while the tank is in motion thus moving around and smashing the driver in the head. I saw this happen and the results were front teeth knocked out and a large gash in the base of the skull.

6. When climbing on tanks - especially when wet - I have seen men slip on the wet steel and take a nasty fall due to the inability to get a foothold and a handhold at the same time. There used to be on a few M 24s a foot rung to step up on, but I have not seen them lately.

7. Every time one operates in a tank as any member of the crew, the M-19 field jacket is both cold and clumsy. It prevents a big man such as myself from getting in and out quickly. Also is annoying, because it catches on all the things sticking out in the tank turret. The end of the sleeve next to the wrist catches on everything. The skirt below the waist cord is another thing that catches on everything.

8. In the closeness of any type tank, bulky clothing can be very much in the way, and sometimes dangerous. In most cases, the fatigue clothes are ill-fitting, have bulky pockets, and by the time a man has on enough clothes to keep warm, he can't move inside the tank, at a speed to be sufficient.