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# RETURN TO EARTH

By

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# UNEDITED ROUGH DRAFT TRANSLATION

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# Return to Earth

by

L.Gil'berg

Old friend - the parachute

Every ship carries along small boats just for the case of an emergency. The air craft, when it first appeared, also needed a rescue boat, which would make it possible for the crew in case of an emergency to float over the waves of the air ocean back to solid ground, just as seafarers are being rescued from a sinking ship.

Such a medium, which allows one to support himself against the air , to decelerate the orderless drop of a flier and safe landing of same, is the parachute.

Already in ancient times primitive umbrellas were used for jumping from high cliffs. But we are in possession of drawings of a rescue apparatus,drawn by the great Leonardo da Vinci. In the XVIII century a Frenchman J.Mongolfe with the aid of a larger umbrella like cupola executed a safe jump from a high tower. Following in his step his countryman Lenorman created a contraption consisting of a textile cupola and suspension line and gave it the name of parachute(from the French words "pare " - to prevent and chute - descent ).

The parachute was being used as a rescue medium for aviators. In half-opened form it was attached to the gondola of a balloon, and prior to jumping the aviator tied or attached the suspension ropes to his own body.

Efforts of fliers to use such parachutes have not been successful. A special avia parachute was necessary. It was produced for the first time in 1911 by a retired lieutenant of Russian Army talented inventor G.Ye.Kotel'nikov. The cupola and shroud lines were folded up into a special knapsack worn by the pilot, and this allowed him in any position to abandon the aircraft and open the parachute already in free fall.

The structural principle of the parachute produced by Kotel'nikov is now used as basis of all modern parachutes. Parachutes saved the lives of thousands of fliers. But now the advent of jet aircraft, flight velocities and altitudes have risen enormously, and it was found here, that the old friend - parachute can no longer guarantee the safety of the flier in an emergency.

The Flier is being Ejected (Shut Out)

If previous fliers abandoned aircraft in case of emergency, by crawling out from the cockpit, then at speeds of 500 km/hr and over this became impossible.

A powerful stream of air exerts great force against any object coming out from the aircraft. Even if the pilot would succeed in getting out from the cockpit, then the stream of air would immediately carry him toward the empennage . A tragic result could not be avoided. Therefore jet aircraft are equipped for the case of an emergency with speciall installations which eject - catapult - the flier together with the seat.

To most rapidly separate the seat with aviator from the aircraft and haul them over the empennage - rudder, most suitable was found to be the pyrotechnical mechanism.

The seat with flier in it is shut out (ejected) from the cockpit, like a round from a gun. The pyrotechnical charge of the ejection mechanism is made up to meet the weight of the flier, seat and equipment, speed and flight altitudes,distance from cockpit to rudder.

So that the seat during catapulting should not be caught by the empennage the pyrotechnical discharge must be sufficiently powerful. But here begin numerous contradictions which must be overcome by the constructor.

During ejection originate more than twentyfold overloads (detailed data on overloads see report " Before Man's Flight " in ZNANIYE - Sila No 10, 1960 ) which

do affect the seat and the flier. True, they are very short lived, these overloads, and by adhering to all the rules of ejection (catapulting) they are endured with relative ease. But when the seat has already broken away from the aircraft the flier experiences even greater overload. The seat is sharply decelerated by the air stream. Even at an altitude of 11000 m, where the layer of air is highly rarefied at a velocity of 1000 km/hr that overload constitutes 33 units (which is an acceleration equalling 33 g); In addition, the flier collides with a counter stream of air with a force of up to 2 tons at an aircraft speed of about 1000 km/hr at medium altitudes. Fortunately the collision lasts only for a short instance- not more than one tenth of a fraction of a second.

When catapulted downward it is easier to avoid collisions with the empennage, the pyrotechnical discharge can be weaker, the overloads are smaller. But such a way of catapulting does not always warrant the saving of the aviator at low flight altitude and is absolutely impossible during the take off of the aircraft.

And it is a fact that emergencies quite often occur at take off. That is why on a majority of high speed aircraft the seats are ejected upwards at quite considerable rate of speed.

On September 8, 1955, for the first time in the history of aviation, at one of the English airfields test pilot Faifield catapulted himself when the aircraft was still on the runway. The seat acquired a speed of 24.4 m/sec, and it was catapulted quite high into the air that the mechanisms could open the basic parachute. Within 4-5 seconds after being catapulted the test pilot came down safely to Earth (landing).

But how do we handle overloads ? The seat is made in such shape that the body of the aviator fits into it very closely and occupies maximum area in it. Before being catapulted the legs are drawn upwards and fixed by special grips, special flaps

or screams
preventing diffusion throw out of arms come forth. In some instances they limit the movements of the head. Aviators wear special anti-overload (anti-G) suits. In addition the seat with flier in it is ejected in such a way that the overloads affect in direction of chest-back. Now the overloads are no longer dreadful.

And how about the impact against the air ! the most exposed part here is the face of the flier. To protect it he wears a special blind. This motion ordinarily brings into action the entire catapulting system.

When the flier pulls on the blind slightly, a special mechanism is being connected, the cockpit canopy is released, other mechanisms activate the supports and grips And suddenly the blind is pulled down completely. The pyrotechnical explosive charge becomes ignited, the seat slides over guide rails and together with the flier in it is being ejected (shut up) into space.

In case the cockpit canopy is wedged and does not open, the upper tip of the chair is shaped so as to allow piercing of the canopy and catapulting through it, bringing no harm to the flier.

Automatic mechanisms control the descent

The first function after being catapulted - stabilizing the orderless flight of the seat, its somersaulting, which may be fatal for humans.

Within one half of a second after ejection a special automatic mechanism releases stabilizing flaps and the so-called parachute " gun" - pyrotechnical arrangement, which activates a pilot parachute, goes into action. The spiralling of the seat is slowed down the stabilizing parachute tilts same along the air stream, and the speed of the seat, which under the effect of inertia forces travels so far practically horizontally, as the aircraft flew, is decelerated to 500 - 600 km/hr.

Now a special lock is released and the pilot-parachute pulls out a new parachute a much larger one, called the brake parachute.

The function of this parachute is to slow down the movement of the seat, to create conditions for the opening of the basic parachute with larger cupola. If this parachute is opened immediately, then the deceleration will be so severe, that the impact could not be withstood even by the most durable parachute material, and the flier will encounter great difficulties from the new batch of extreme overloads. There is still another reason for delaying the opening of the basic parachute. If the catapulting was done at greater altitude, it is important first of all to descert as fast as possible to an altitude of 3 - 4 thousand meters. It is necessary to protect the flier against anoxia (oxygen deficiency) and reduced barometric pressure of the atmosphere, against low temperature and against cosmic rays. In this case a special automat - barostatic regulator - delays the opening of the basic parachute to an altitude of 3000 m.

And so, after a certain time of descending the brake parachute pulls out the basic one. If the overloads are still above permissible limit, then a special device additionally delays the release of basic parachute for a certain period of time.

When, finally, the entire parachute system has been brought into action, still another mechanism opens the locks, holding down the flier in the seat, and it falls off. From then on the descent and landing of man by parachute is quite normal.

Man in Protective clothing

The continuously growing flight altitude of modern aircraft complicates the problem of rescuing the flier. Already at an altitude of 3-4 km and oxygen deficiency is being felt. Conventional oxygen devices (devices enriching the inhaled air with oxygen, but do not raise the pressure in the lungs) raise the altitude boundary to 12 km. At higher altitudes, in order not to permit anoxia, it is necessary to raise the atmospheric pressure of the atmosphere surrounding the flier. Further-

more, at an altitude of more than 9 km there are other disorders, connected with low barometric pressure ( pains in the joints, in the stomach etc).

In the aircraft the flier is usually protected by a special airtight cockpit (pressurized cabin), in which proper pressure and temperature are maintained. But how would it be if the need arises for abandoning the aircraft ?Even in the very cabin in case of emergency sudden depressurization may take place (explosive decompression). Here come to the rescue the compensation suits and high altitude protective suits.

In the protective suit, as in the pressurized cabin, man's body is exposed to uniform air pressure, air which circulates freely between the surface of the body and the airtight envelope of the protective suit.

The high altitude protective suit is in essence a very light elastic, gas impermeable " cabin " fitted directly over the body of the flier. For the convenience of movement hinges are placed in points of basic joints.

In the compensation suit under higher oxygen pressure is situated only the head ( thanks to the hermetically sealed helmet). The balancing pressure against the body is produced mechanically by tightening the shell of the suit, which fits closely to the body.

As long as the pressurized cabin is in good working order the protective clothing does not hamper the movements of the flier. Oxygen flows into the helmet from the source carried on board the aircraft. But as soon as the air pressure in the cabin drops the high altitude mechanisms go into action that connect the oxygen supply with pressure necessary for given flight altitude, the protective clothing becomes inflated automatically. If the flier wears a compensation suit then the chambers of the tightening devices become inflated and they get tightly around the body.

The compensation suit allows to remain at higher altitude after depressurization of cabin but only for a short stretch of time, while the protective helmet offers the possibility of continuing the flight in altitude. This and other equipment (mainly the helmet) do quite well protect the flier against impact with air stream during the catapulting. The automatic mechanisms instantaneously cut off all wires (cohduits) and hoses, connecting the protective suit with the aircraft, they seal the sockets hermetically, cut in oxygen supply from parachute oxygen supply bottles.

To protect against the effect of low and high temperatures the top of the high altitude compensation suit is lined with a ventilating (for transfer of heat and moisture) and heat insulating layer, and during flight over seas it also has a sea rescue attachment in it. The high altitude protective clothing is in itself a ventilating unit and normally has buoyancy . The addition of a heat insulating layer to it or the addition of a special suit allows man to remain even for a longer period of time even in icy water.

Thanks to efforts of scientists and constructors presently we have the most convenient and safe structures of catapulting seats, helmets and compensation suits.

A cosmonaut comes down to landing

It appeared, that everything has been done, to rescue the flier from an air craft in trouble. But aviation is developing rapidly, very rapidly. And things which were good only short 2 - 3 years ago, are already obsolete by now. Ejection seats, which are suitable for rescue from aircraft, flying at subsonic velocities, are of no use to the flier, if trouble visits (besets) the aircraft travelling at great supersonic speeds - the seat must be ejected with greater impetus, the over loads are greater, the impact against air stream is more severe. And it is a fact

that many aircraft are already travelling at speeds of more than 2000 km/hr. Experimental rocket aircraft attained speeds of 4000 km/hr. Already now is needed a rescue equipment for pilots of rocket aircraft and cosmonauts of inhabited satellites.

In recent years, according to western press releases, a number of original devices has been created. And so for example, new designs of ejection seats have been created. Instead of pyrotechnical cartridges the seats are provided with a rocket power plant. Prior to catapulting such a seat is turned 90°. The flier is ejected lying on his back; in such a position it is much easier to endure greater overloads. And into the air stream it falls already, as to say, with bottom forward. The lower part of the seat protects the person against velocity head, the best samples of such seats allow to catapult at a speed of up to 2400 km/hr.

Also developed were the first samples of special rescue capsules. This is like a small cabin, which is formed by mobile walls. Such a capsule closes automatically and becomes pressurized prior to being catapulted, it protects against counter flow of air and its secures safe landing. It also serves as container for rescue media (parachutes, emergency supply, oxygen equipment etc.) and as a rescue raft when falling into the water. It releases the flier from the need of wearing a larger amount of equipment.

The special pyrotechnical cartridge closes the three louvers of the door thus forming a pressurized section. After the capsule is closed, and no immediate catapulting is required, the pilot can continue his flight - control handle (stick) remains in the capsule, and through a special little window he can see the basic piloting instruments. Having dropped down to a safe altitude, the flier can open the door of the capsule, and in case of new trouble, connect the second pyrotechnical cartridge and repeat the entire cycle of readying for catapulting.

After catapulting the capsule descents with the aid of a parachute system.

During the descent from the capsule come out four telescopic rods - they stabilize the landing. They are also provided with floats.

Under development are also samples of separating cockpits, which in essence represent the entire forward part of the fuselage with cockpit- in case of emergency this entire section separates itself from the aircraft and descends on parachutes.

The development of this system appears to be the method of rescuing astronauts from satellites.

Included in the development are also rescue systems. The cabin with pilot is provided with a quite powerful rocket power plant, which can rescue the cosmonaut in case of trouble with the rocket even at blast off- the capsule breaks away from the rocket, it flies up high into the air and then lands on parachutes. The capacities of the power plant, which ejects the capsule, are sufficient to get away from the carrier rocket even at the so-called active section of the trajectory, i.e. when the basic power plants of the rocket are in operation.

Yuriy Gagarin to the Readers of the journal ZNANIYE - SILA

In the fourth number of the journal ZNANIYE - SILA for this year I read an article entitled " Fantasy and Soviet Fact Occurrence ". In it is told about a special cosmic number of your journal, published several years ago, It is stated in this report " we still do not know whether Yuriy Gagarin had this journal in his hands, we like to think that he did ".

The author of the report was in no error: yes, I did hold and attentively read this journal. In it there is a large chapter devoted to the first flight of Soviet people into cosmos. And even it appeared fantastic at that time , but the journal acquired the form of realistic prediction, it even contained photos of imaginary cosmonauts, their names, see Familin biography, And the front cover depicted the

blast off of a rocket and below it the date - 1974. Generally speaking the readers held the ZNANIYE-SILA edition for the year 1974...

Now it is a pleasure to leaf through this edition. When was it published - I do remember very well - I was then a student at a technical institute, and I was already an amateur pilot. I have enthusiastically told about it to comrades at the aero club, how Soviet people flew into cosmos. The youngsters listened and smiled and then asked:

where did you read all that ?

In the journal ZNANIYE - SILA

And as if I would have said...This journal likes to print fantastic stories.

You may as well ask why has this cosmic number of the journal ZNANIYE - SILA come to my mind? Perhaps, because many data in it were considered as perfectly serious scientific-popular reports. For example, the fantastic story of my predecessor - commander of ship "LUNA-1" M.A.Sedov. Before his flight he writes: " The development of jet technology in our country laid the foundation for interplanetary journeys. You know that already several years ago began regular ultra long range trips of passenger rocket aircraft into the ionosphere. The flight condition in these rocket aircraft is very similar to interplanetary flight conditio s . Over there and here there is sharp overload at take off and absence of gravity in the center of the path.

Of course, all kinds of unexpected things are possible, it is uncertain whether we will encounter serious obstables. Science has already become acquainted with cosmic space. For four years already Soviet scientists are receiving regular information from their helpers from an altitude of 35 thousand km. I am thinking here of the instruments, installed on man-made Earth satellite.

The trip Earth-Moon has also been made, so far, true, without people - by automatic rockets. If you do remember, the first flight of such a rocket was unsuccessful:

because of failure of the electronic regulator, which cut off the propulsion unit ahead of time, the rocket did not reach the Moon and is now travelling in space, having become converted into the second man-made Earth satellite. But the second rocket made a succesful landing on the Moon near the Ptolomeus crater and heralded this feat by the explosion of a special powder charge.

But even more than that was furnished us by the latest rockets - third and fourth. One of them flew around the Moon and delivered to Earth an unusually interesting motion picture film, in which people have for the first time seen the other side of the Moon.

And so, these devices have explored the road and now people are being dispatched along that road ".

Today readers of the journal ZNANIYE-SILA can already compare the fantasy with reality.

In conclusion please allow me to express my gratitude to the editing office for sending me the journal for the year 1974. I feel like to extend my heartfelt greetings to the young readers of the journal ZNANIYE -SILA - to craftsman, students. By reading this journal, they, I am certain, do well know that knowledge is actually strength.

Yu. Gagarin.