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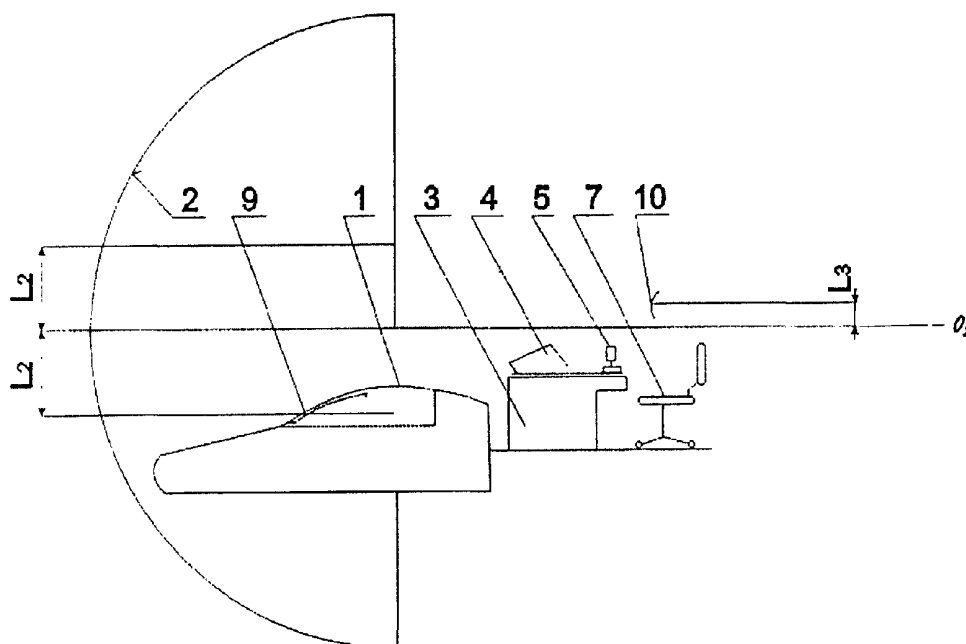
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(72) Inventor: ZÁBRANSK, Peter [CZ/CZ]; Argentinská 38, 170 05 Praha 7 (CZ).
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(54) Title: FLIGHT SIMULATION DEVICE



(57) Abstract: Flight simulation device containing the simulator cabin, main display screen and instructor's area. One single room contains simulator cabin (1) in front of which the main display screen (2) is located. Horizontal axis ( $O_2$ ) of the screen (2) is above the center (9) of the window of cabin (1), which is followed by instructor's area (3) located on an elevated place. The center (10) of virtual window of instructor's area (3) is above the horizontal axis ( $O_2$ ) of the main display surface (2), and deviation of the center (10) of instructor's area (3) from vertical axis ( $O_1$ ) of the main display screen (2) is equal or smaller than  $\pm 15^\circ$ .



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Fight simulation device

### Background of the invention

The invention relates to fight simulation device pertains to the ground aircraft simulation consisting of simulator cabin, main display screen and instructor's area.

### Description of prior art

The generally known ground aircraft simulation device, i.e. simulators with a large display screen where the trainee pilot can see the simulated space in front of him or around. The display screen is located in front of the simulator cabin containing trainee pilot's seat. The instructor's area is usually in the neighbouring room. The instructor's area contains one or more small monitors for current check up of trainee pilot's aircraft. If the instructor's area is located in a neighbouring room the instructor does not have any opportunity to check the behaviour of the trainee pilot on the large display screen. Disadvantage of this layout is that it does not provide the instructor with the possibility to orientate himself in the trainee pilot's area for "within visual range" distances. It does not provide interactive training capability based on the interaction between the trainee pilot and the instructor when the trainee pilot controls the main aircraft and the instructor controls instructor's aircraft in one virtual space and at the same time "within visual range". The reason is that the small monitor or monitors in instructor's area do not provide sufficient horizontal and vertical angle of view as the large display screen does. In such a case the instructor is not able to response accurately from his instructor's area to the trainee pilot's aircraft movements. At the same time it is necessary that the control of movements of instructor's aircraft be as real as possible. This is particularly important when training formation flights or combat missions when instructor's aircraft represents the target.

Also known are the simulators that use an aircraft with pre-programmed artificial intelligence as an air target for the trainee pilot. The disadvantage of such simulators is that the instructor cannot control the target aircraft directly, and cannot directly correct its flight path either.

### Summary of the invention

Fight simulation device consists of trainee pilot's cabin, main display screen and instructor's area. The principle of the invention consists in that the simulator cabin in

front of which is the main display screen, is located in one single room. The horizontal axis of the main display screen passes above the centre of the cabin front window while the instructor's area is located on an elevated place behind the cabin. The centre of the virtual front window of instructor's area is located above the horizontal axis of the main display screen. Deviation of the centre of instructor's area from vertical axis of the main display screen is equal or smaller than  $\pm 15^\circ$ . The horizontal distance between the center of the seat of the simulator cabin and the center of instructor's seat is smaller than twice the radius of the main display screen. The vertical distance between the center of the virtual front window of instructor's area and horizontal axis of the main display screen is smaller than one half of the vertical distance between the center of the cabin front window and the horizontal axis of the main display screen. Instructor's area is provided with at least one monitor and with maneuvering controls of instructor's aircraft such as control stick and throttle lever. The main display screen is shaped as a coherently spheric surface or is composed of several segments in the shape of straight surfaces.

The advantage of this layout is that instructor's area is located very near behind trainee pilot's cabin. That provides much better view of the main display screen also from instructor's area. The instructor can create various simulated situations for the trainee pilot. The instructor controls cooperating aircraft when training formation flights as well as the behaviour of adversary aircraft when training combat situations, and the like. If needed, he uses his feeling and experience to response directly to the behavior of the trainee pilot, and creates conditions, which are very similar to real situations. If both instructors and trainee pilots aircraft are within visual range, the instructor pilots his aircraft, and checks the activities of the trainee pilot at the same time. He can see direct response of the trainee pilot to instructor's aircraft. He can modify his own aircraft flight path according to the trainee pilot responses. The advantage of live piloting of instructor's aircraft consists in that instructor's aircraft does not fly exactly according to its preset programme but wobbles slightly and moves like a true aircraft with all piloting mistakes that the trainee pilot must response to, particularly when training the synchronized formation flight. If the instructor pilots instructor's aircraft as an adversary aircraft in close-in combat, he can create pre-mediated maneuvers to improve the quality of the training, making use of attitude determination by all available means. This layout increases the use value of the simulators and reduces number of the simulators needed for the synchronize formation and close in combat training to a half. The

following are the examples of selected exercises particularly suitable for pilot training: synchronize formation at various levels, circuit flight in formation, non-normal procedures in formation, both air-to-surface and air-to-air attacks and close-in combat.

#### Description of Drawings

The invention will be specified in detail by means of the drawing in which Figure 1 represents the ground aircraft simulation device seen from above, and Figure 2 shows the side view of the same device.

#### Examples of embodiments of the invention

Fight simulation device is located in a single room containing the trainee pilot cabin 1, main display screen 2, which is located in front of the cabin 1, and instructor's area 3 which is behind the cabin 1. The shape and internal layout of the cabin 1 corresponds to the cabin of the corresponding type of aircraft, which the trainee pilot learns to control. Cabin 1 contains trainee pilot seat 8 (Fig. 1) in front of which is the commonly known window to the main display screen 2. The center 9 of cabin 1 (Fig. 2) is at the eye level of the trainee pilot. Inside the cabin 1 there are all the necessary controls and control instruments as in real aircraft. The main display screen 2, which is in front of cabin 1, is in the shape of a coherently spheric surface. The spheric surface can also be composed of several straight segments. Angle of view of the spheric surface is  $140^\circ$  horizontally and  $90^\circ$  vertically. The horizontal axis  $O_2$  of the main display surface 2 is located above the center 9 of the window of the cabin 1. Instructor's area 3 is located on an elevated place behind the cabin 2. Instructor's area 3 is provided with instructor's seat 7, control stick 5 of instructor's aircraft and instructor's aircraft controls 6. Instructor's area 3 is equipped with at least one monitor 4. The example of a concrete layout (Fig. 1) shows three monitors 4.1 to 4.3. These monitors display both instructor's aircraft and trainee pilot's aircraft in the extent of up to  $140^\circ$  horizontally. Deviation of the center of seat 7 of instructor's area 3 from vertical axis  $O_1$  of the main display screen 2 is smaller than angle  $\alpha$  which is equal or smaller than  $\pm 15^\circ$ . The center 10 of virtual window of instructor's area 3 is at instructor's eyes level above horizontal axis  $O_2$  of the main display screen 2. Horizontal distance  $L_1$  of the vertical plane passing through the center of seat 8 of cabin 1, from parallel vertical plane passing through the center of seat 7 of the instructor is smaller than twice the radius  $r_1$  of the main display screen 2. Vertical distance  $L_3$  between the center 10 of the virtual window of instructor's area 3 and

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horizontal axis  $O_2$  of the main display screen 2 is smaller than one half of vertical distance  $I_2$  between the center 9 of window of the cabin 1 and horizontal axis  $O_2$  of the main display screen 2.

Both the instructor and the trainee pilot have a good view of the main display screen 2 on which both instructor's aircraft and trainee pilot's aircraft are projected. In addition the monitors 4.1 to 4.3 display for the instructor the terrain in front of his aircraft, information on flight instruments of his aircraft, information on aircraft position on horizontal map, i.e. on aircraft position in the ground plane of virtual space. The instructor controls his aircraft, which is shown on the main display screen 2 and on monitors 4.1 to 4.3 of instructor's area 3. The type of activity that the trainee pilot is training determines instructor's piloting and controlling his aircraft and correcting its flight path. The situations trained are formation flights of couples or groups. When training combat situations the instructor pilots the aircraft, which is supposed to be the target for trainee pilot's aircraft. When training close-in air combats (dogfights) the instructor's aircraft represents an air adversary. During the training of various situations the instructor monitors whether the trainee pilot responses to simulated situations, and evaluates whether he responses correctly.

#### Industrial applicability

The invention can be used in all types of ground simulation device used for pilot training for various types of aircraft and helicopters.

## CLAIMS

1. Fight simulation device containing the simulator cabin, main display screen and instructor's area characterized in that one single room contains simulator cabin (1) in front of which the main display screen (2) is located, horizontal axis ( $O_2$ ) of the screen (2) is above the center (9) of the window of cabin (1), which is followed by instructor's area (3) located on an elevated place, the center (10) of virtual window of instructor's area (3) is above the horizontal axis ( $O_2$ ) of the main display surface (2), and deviation of the center (10) of instructor's area (3) from vertical axis ( $O_1$ ) of the main display screen (2) is equal or smaller than  $\pm 15^\circ$ .
2. Fight simulation device according to claim 1, characterized in that the horizontal distance ( $L_1$ ) between the center (10) of seat (8) of cabin (1) and the center of seat (7) of the instructor is smaller than twice the radius ( $r_1$ ) of the main display surface (2), and vertical distance ( $L_3$ ) between the center (10) of window of instructor's area (3), and horizontal axis ( $O_2$ ) of the main display screen (2) is smaller than one half of the vertical distance ( $L_2$ ) between the center (9) of the window of the cabin (1) and horizontal axis ( $O_2$ ) of the main display surface (2).
3. Fight simulation device according to claim 1 and 2, characterized in that instructor's area (3) is equipped with at least one monitor (4).
4. Fight simulation device according to claim 1 to 3, characterized in that instructor's area (3) is equipped with controls for maneuvering and piloting the instructor's aircraft, such as control stick (5) and control elements (6) of instructor's aircraft.
5. Fight simulation device according to claim 1 to 4, characterized in that the main display surface (2) is shaped as a spheric plane which is coherently rounded or composed of several segments in the shape of straight planes.

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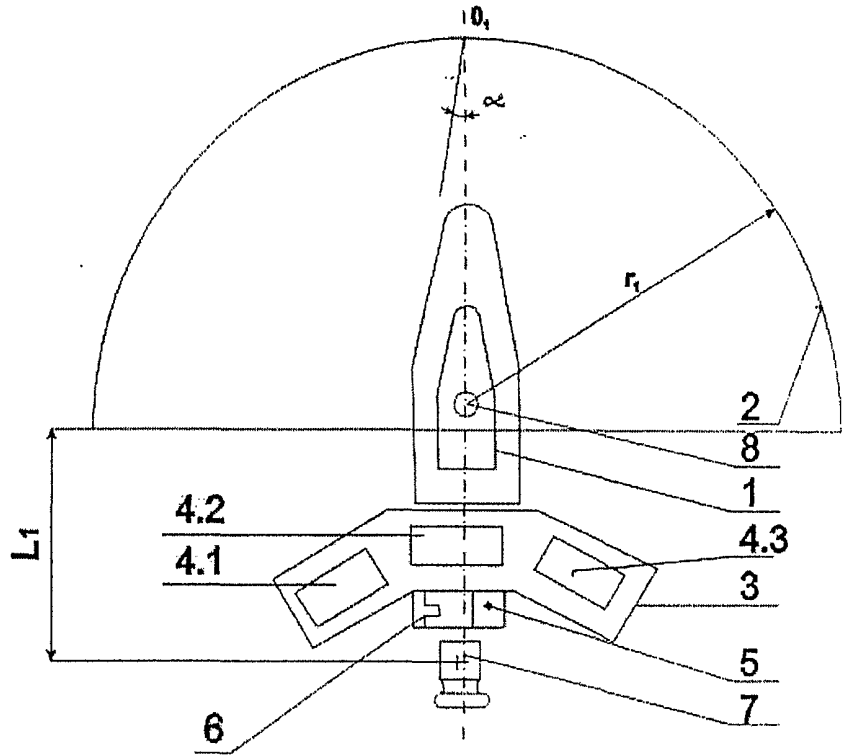


Fig. 1

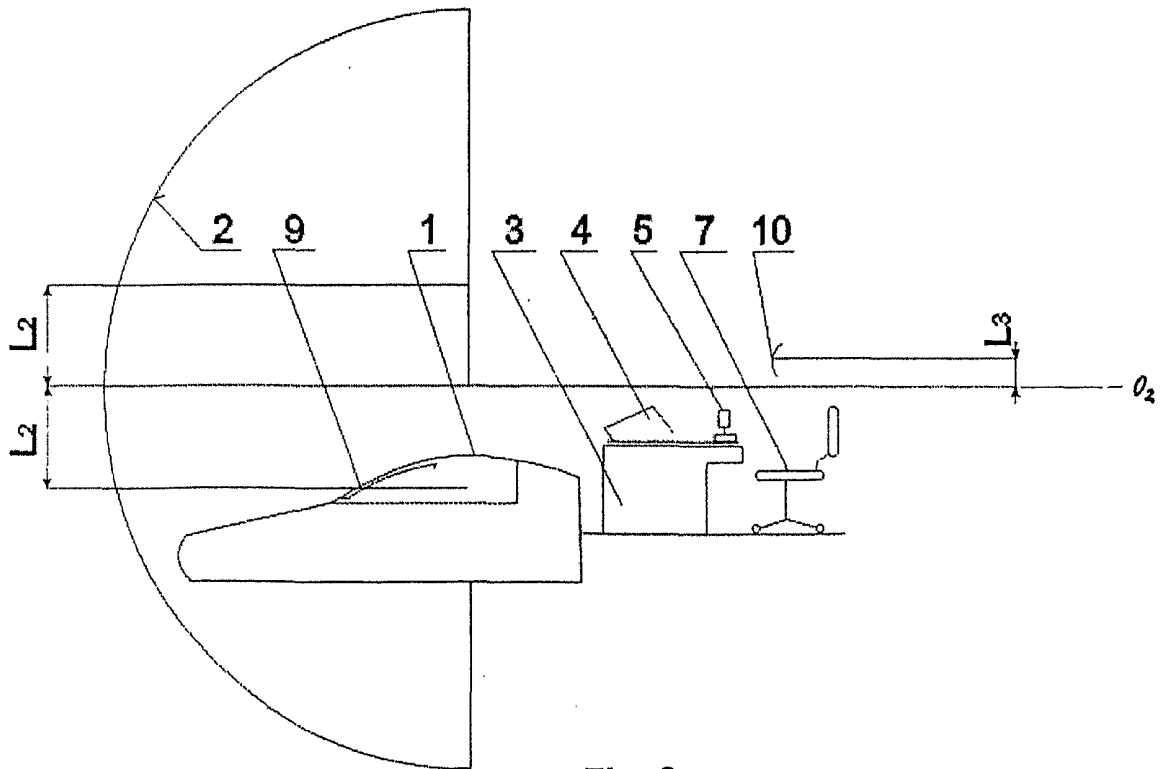


Fig. 2

INTERNATIONAL SEARCH REPORT

Int: application No  
PCT/CZ 01/00054

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G09B9/00 G09B9/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 G09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPO-Internal, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

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- \* & \* document member of the same patent family

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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  Königer, A



## INTERNATIONAL SEARCH REPORT

 Int                      Application No  
 PCT/CZ 01/00054

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