

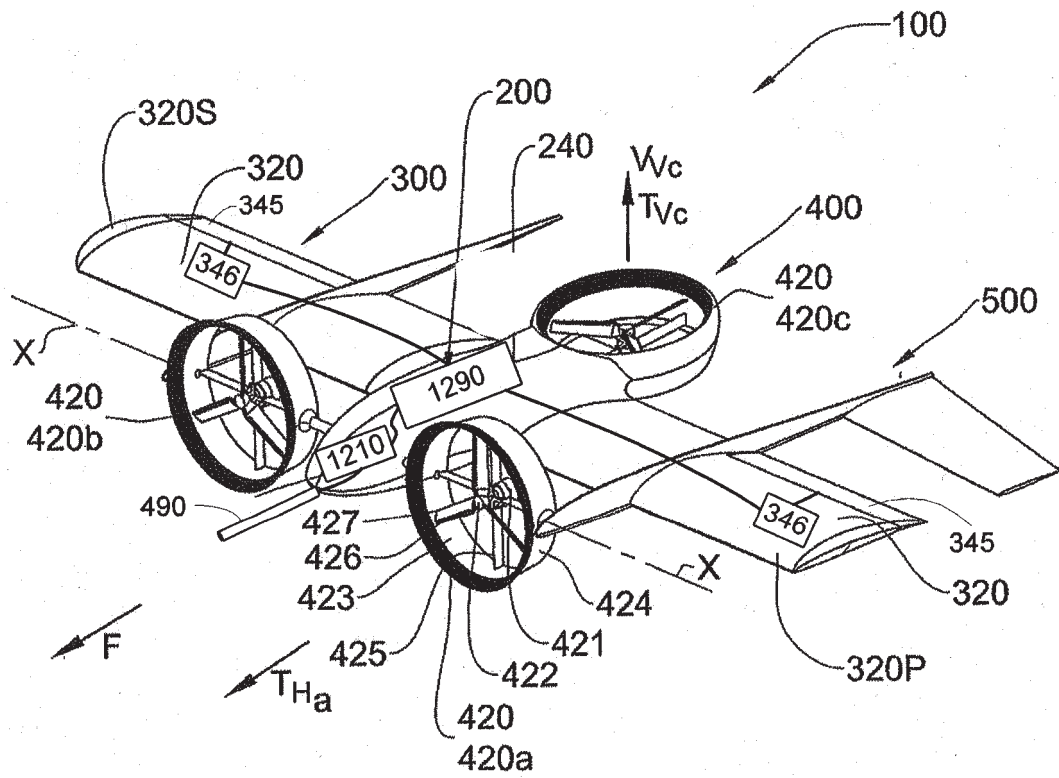


Fig. 1A

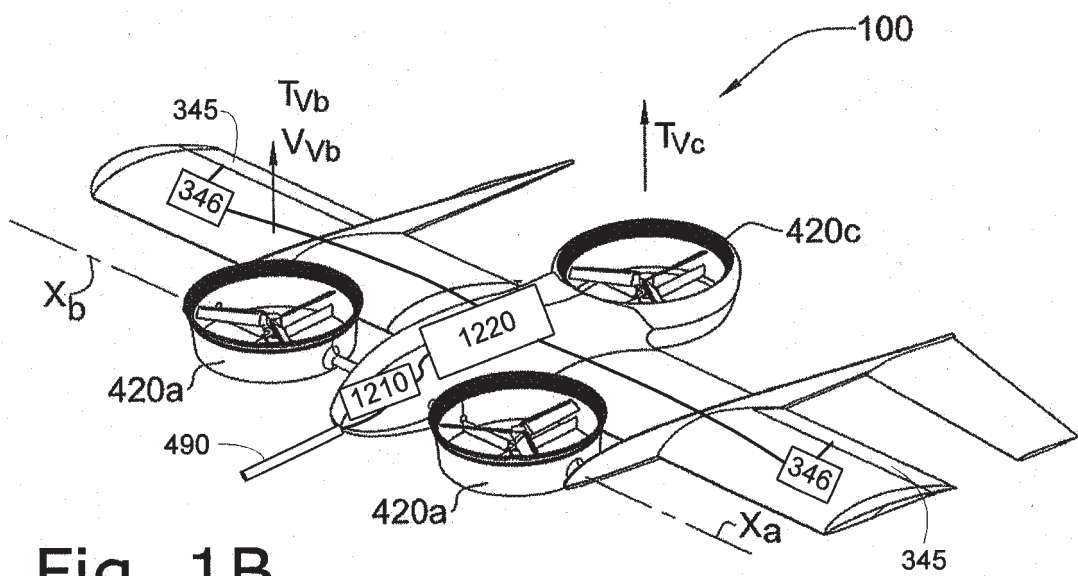


Fig. 1B

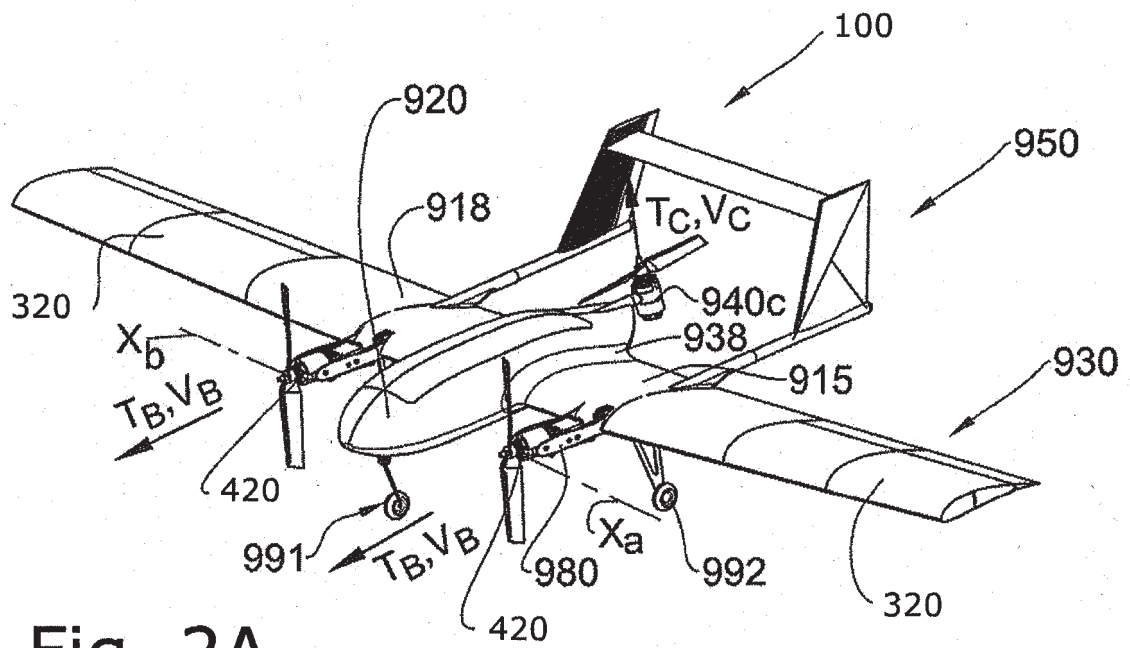


Fig. 2A

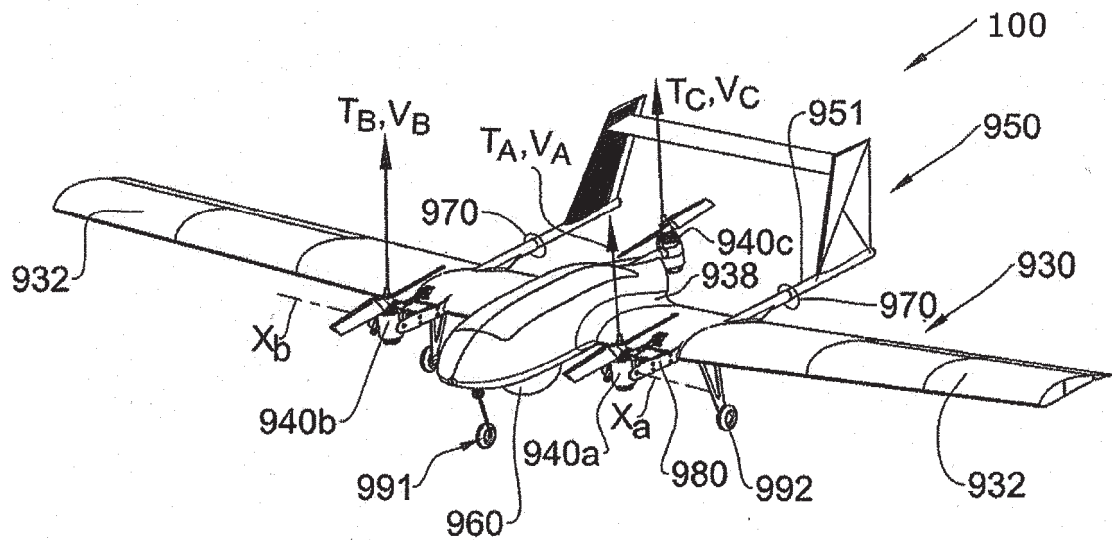
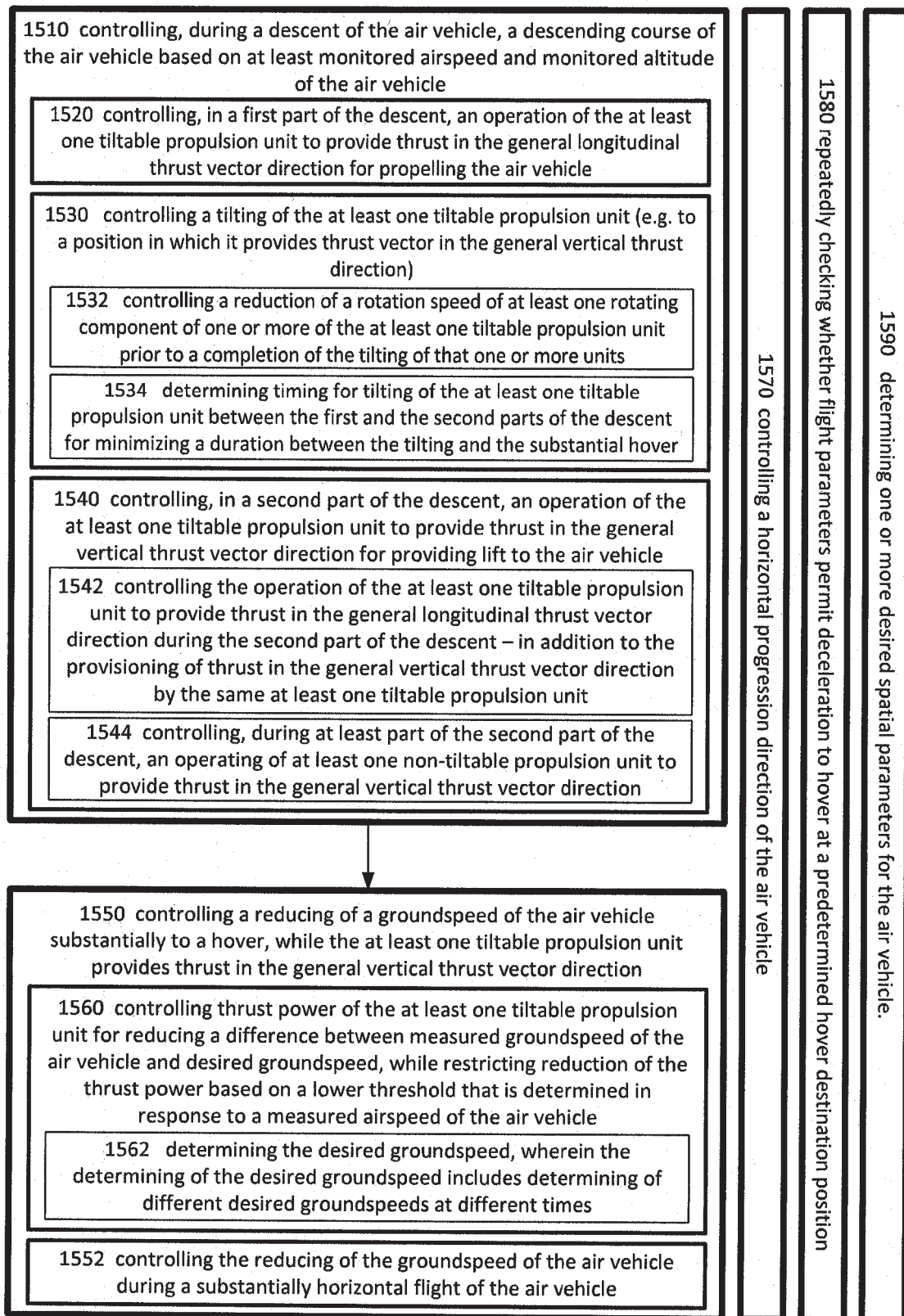
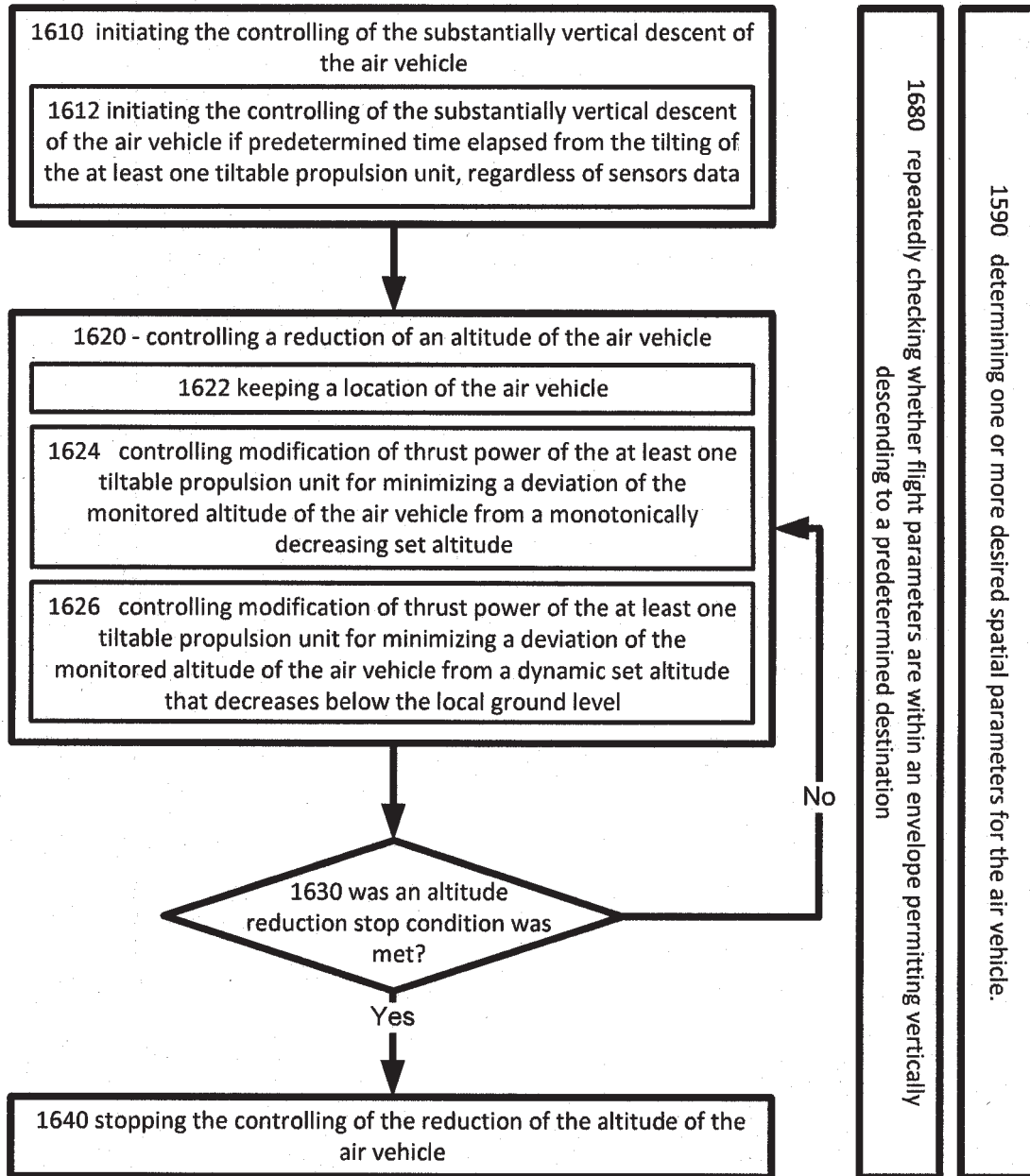


Fig. 2B



1500

Fig. 3A



1600

Fig. 3B

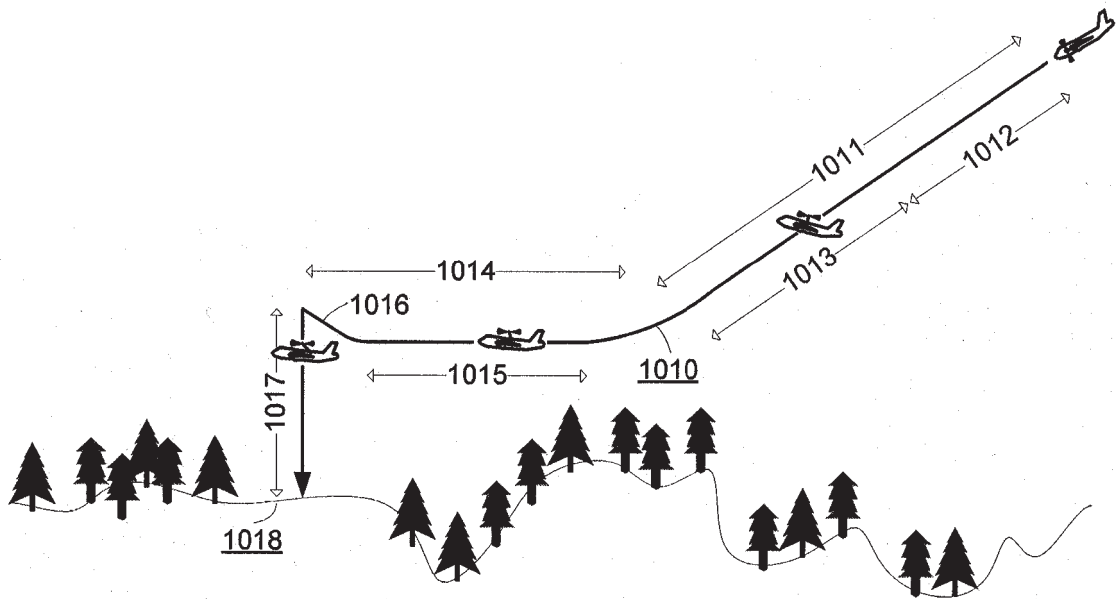


Fig. 4A

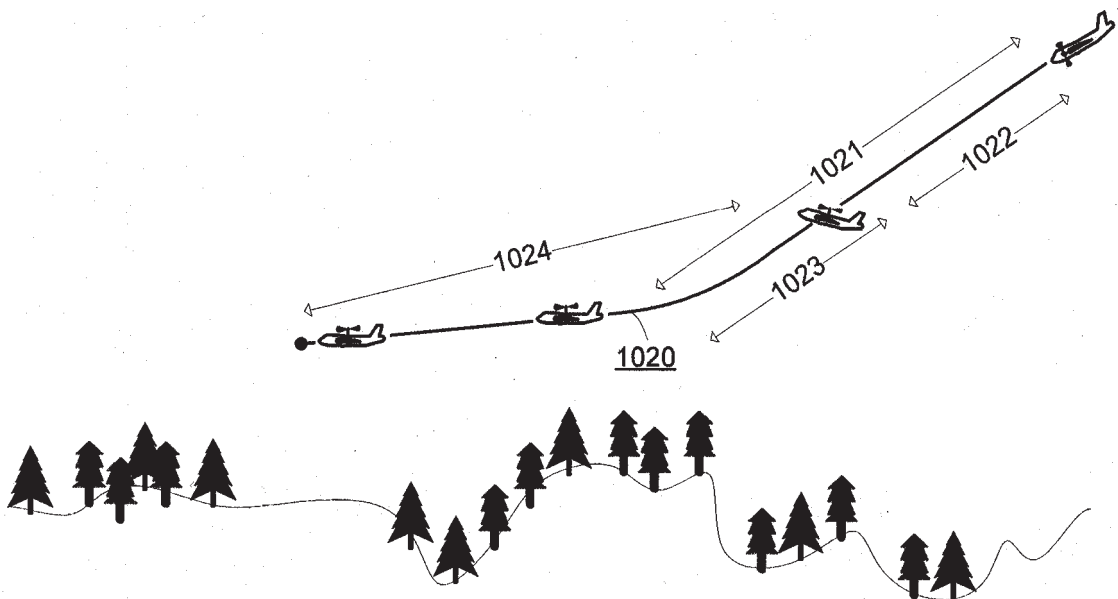


Fig. 4B

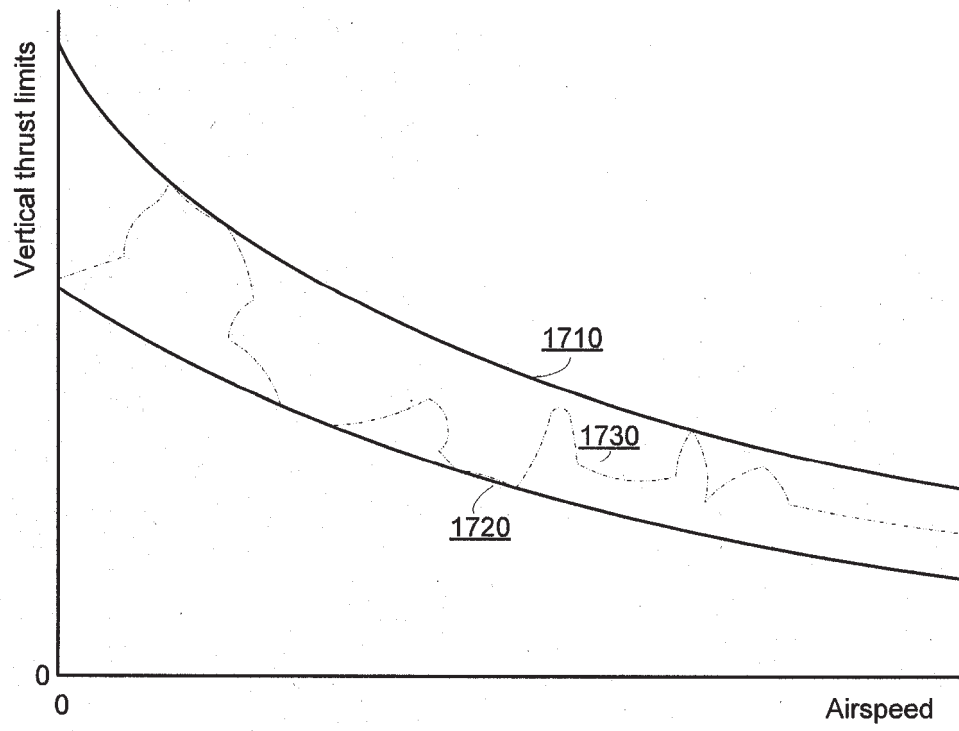
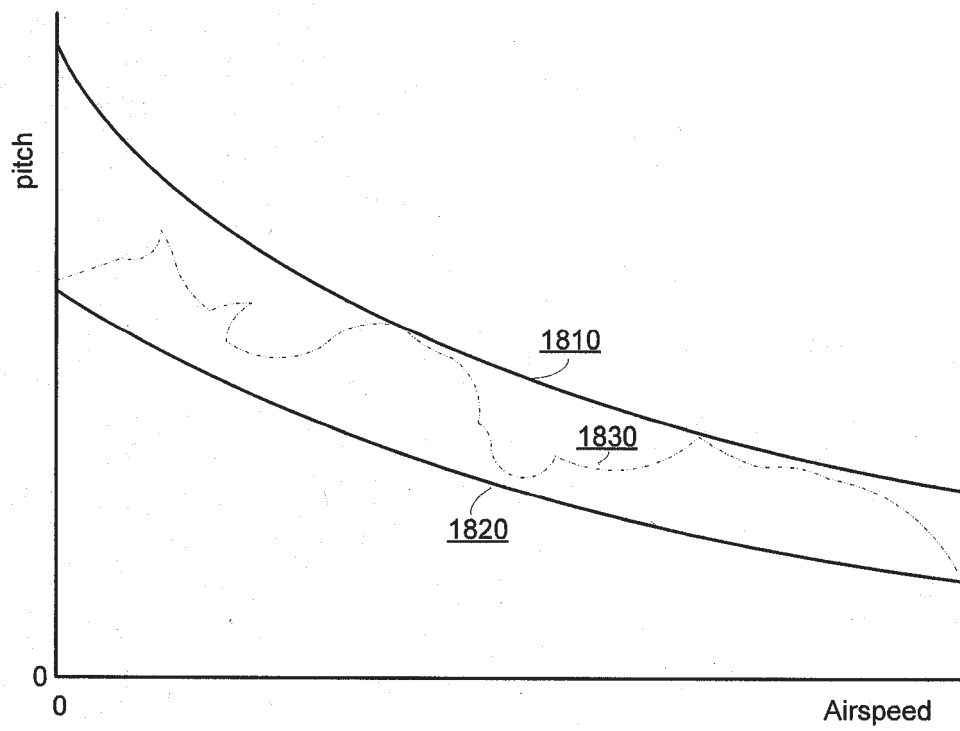


Fig. 5

**Fig. 6**

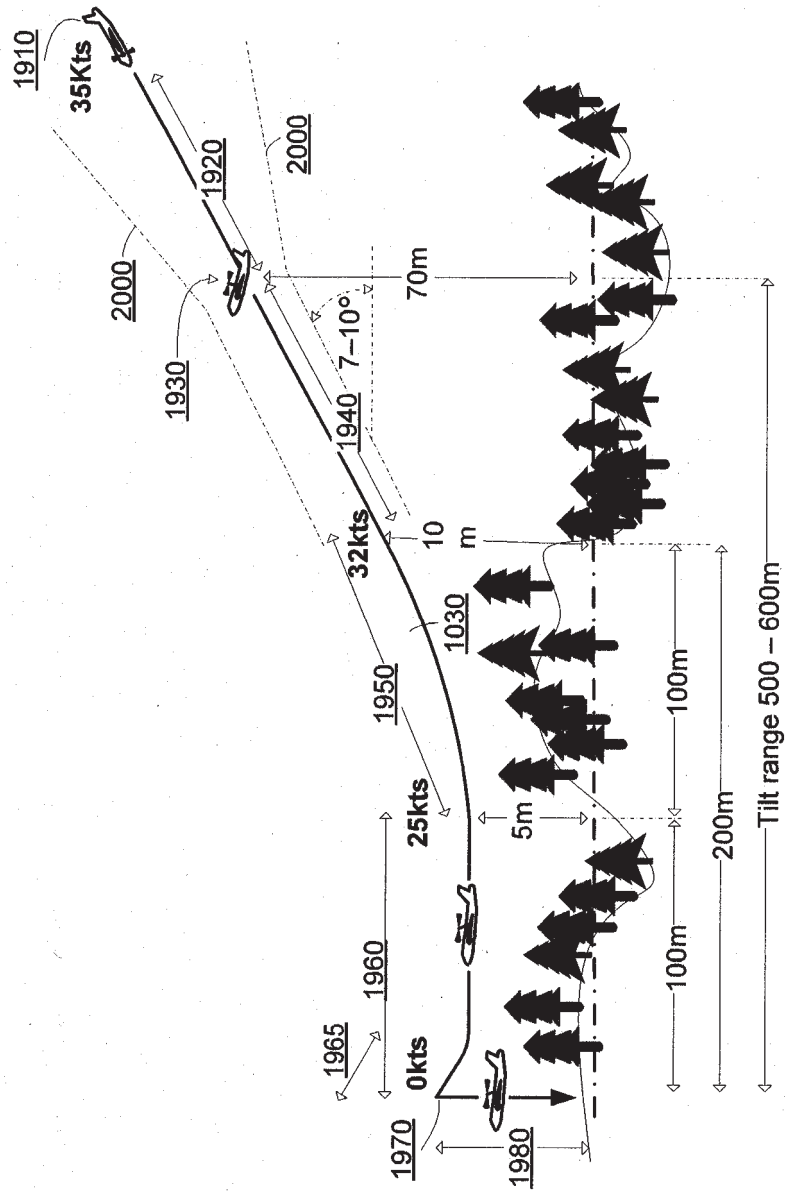


Fig. 7

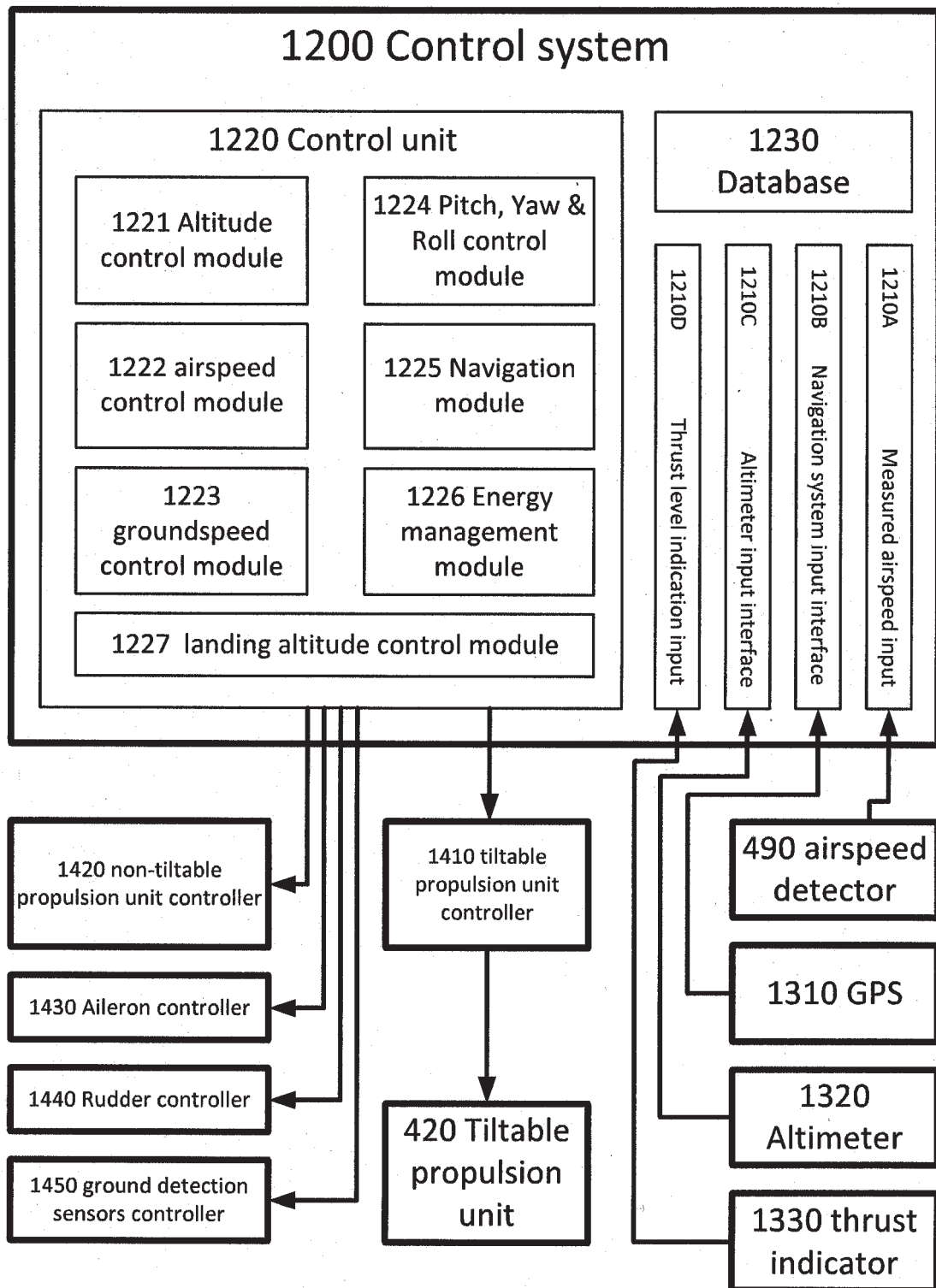


Fig. 8

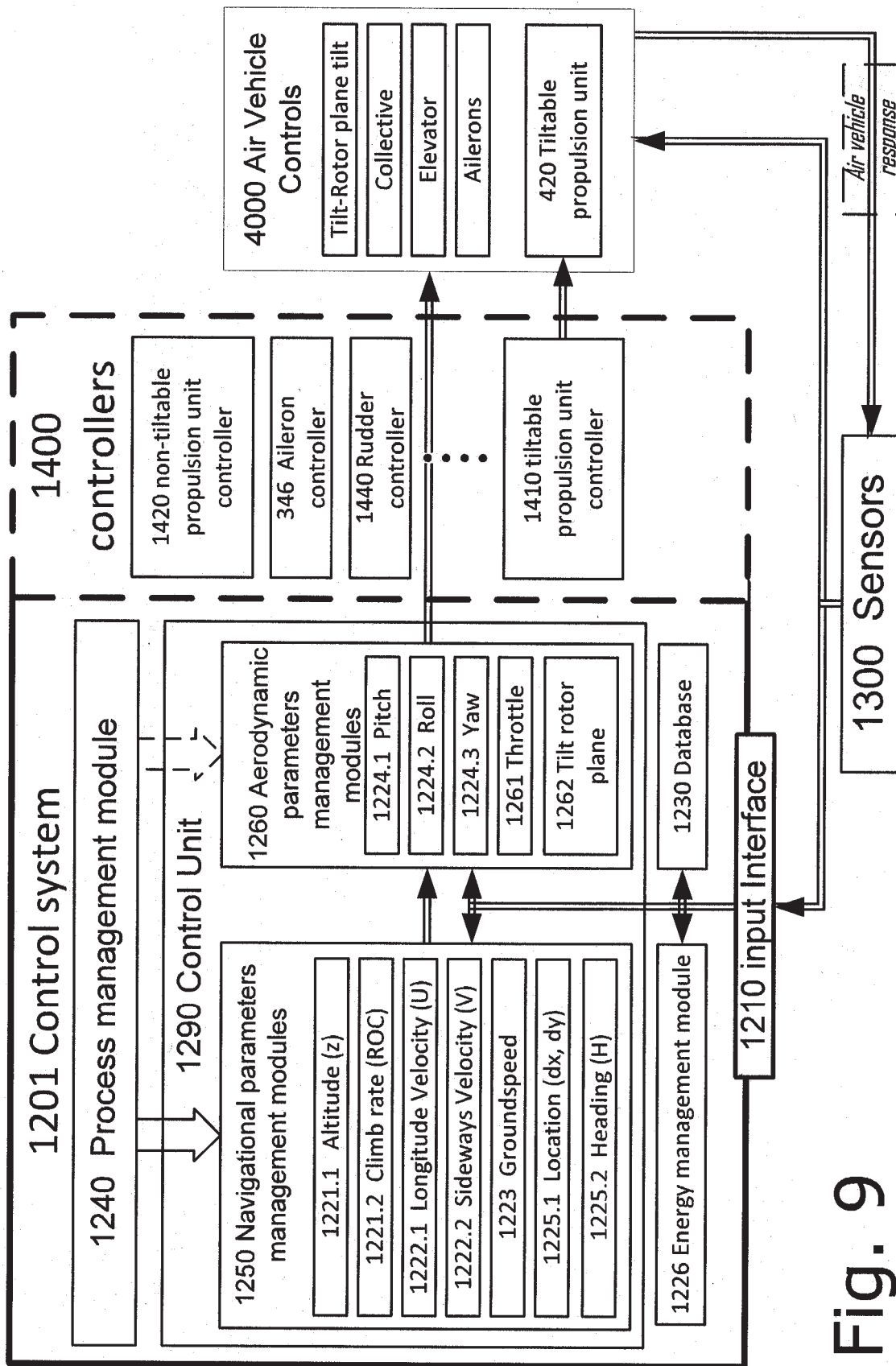
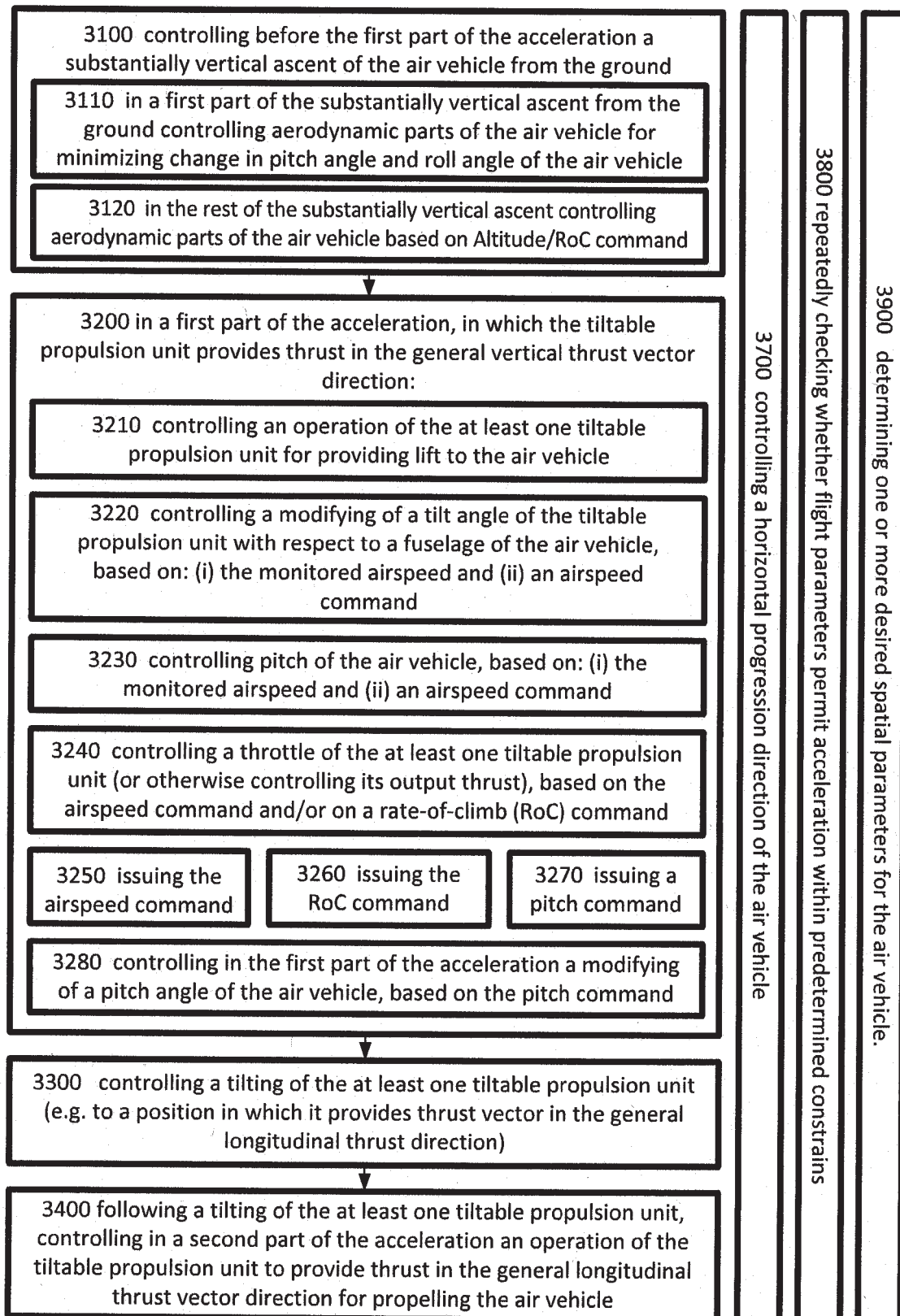


Fig. 9



3000

Fig. 10

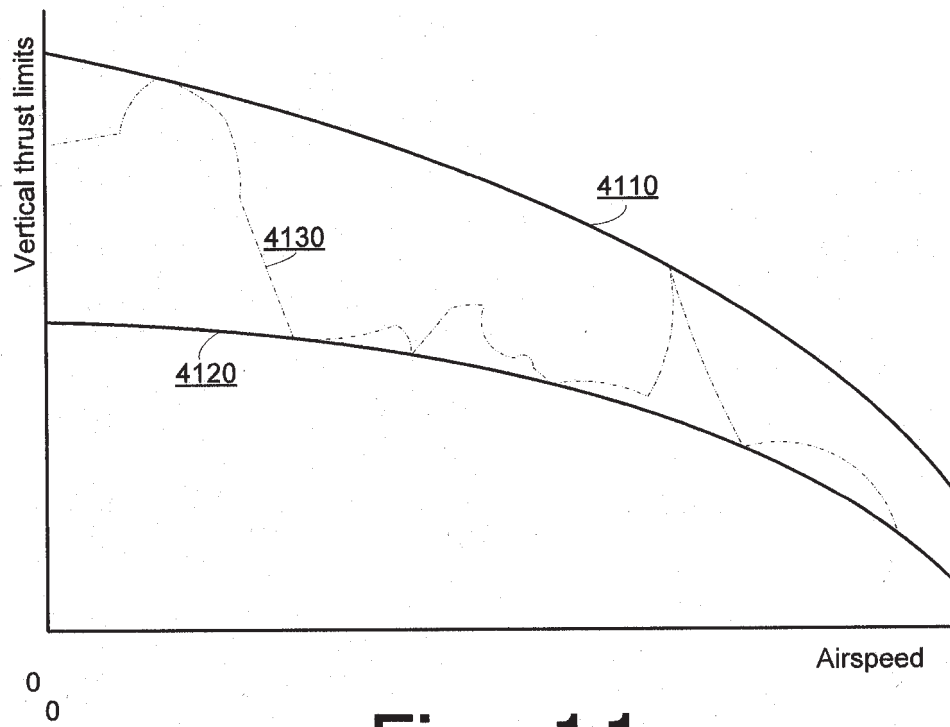


Fig. 11

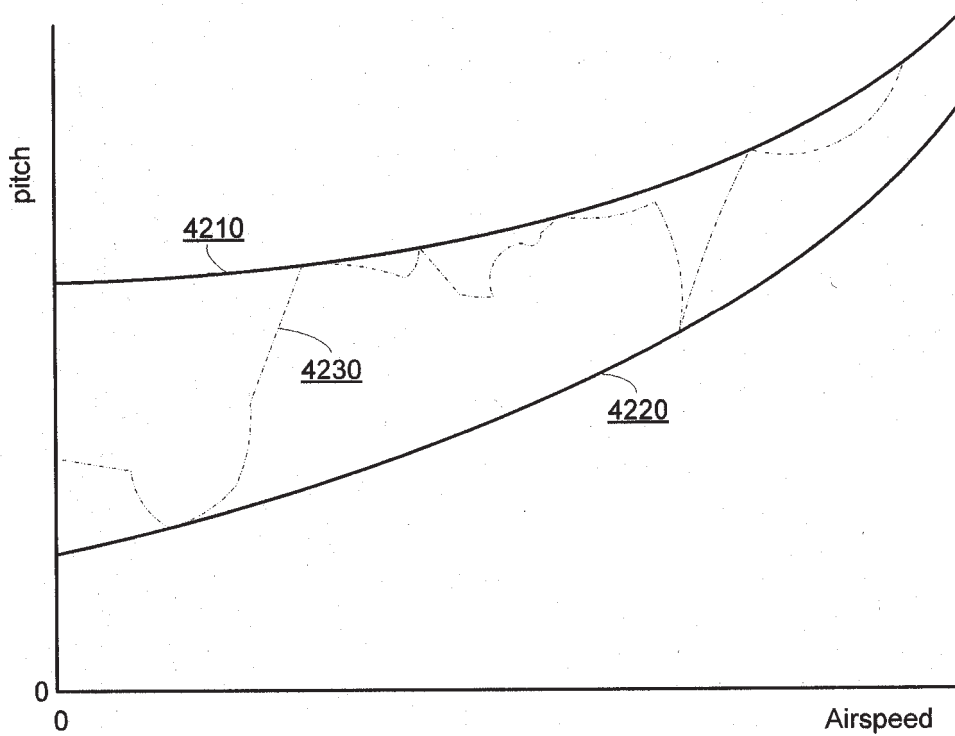


Fig. 12

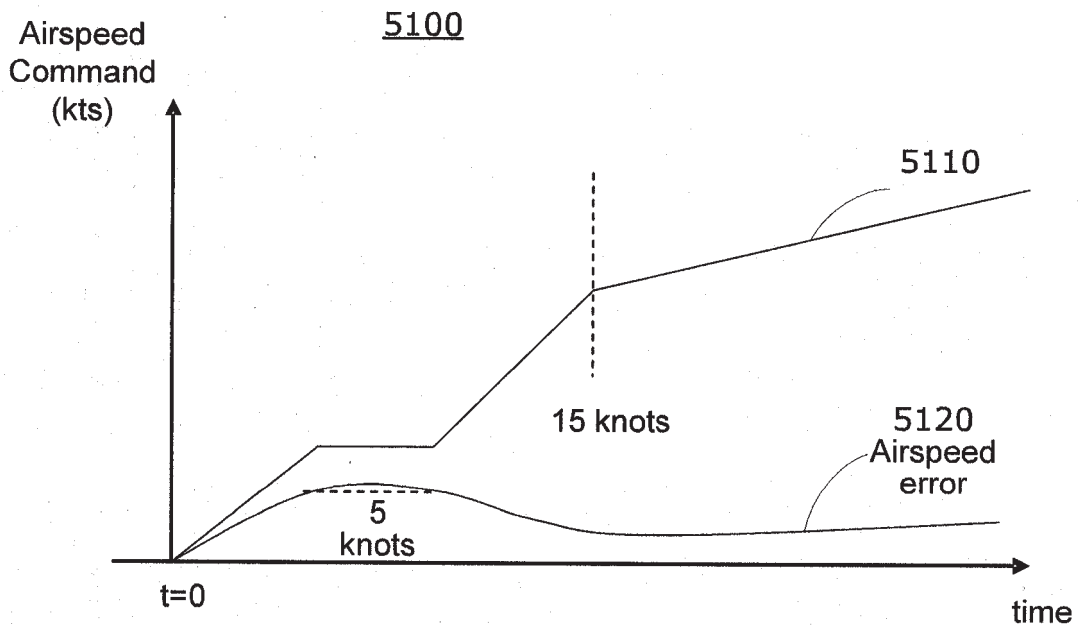


Fig. 13

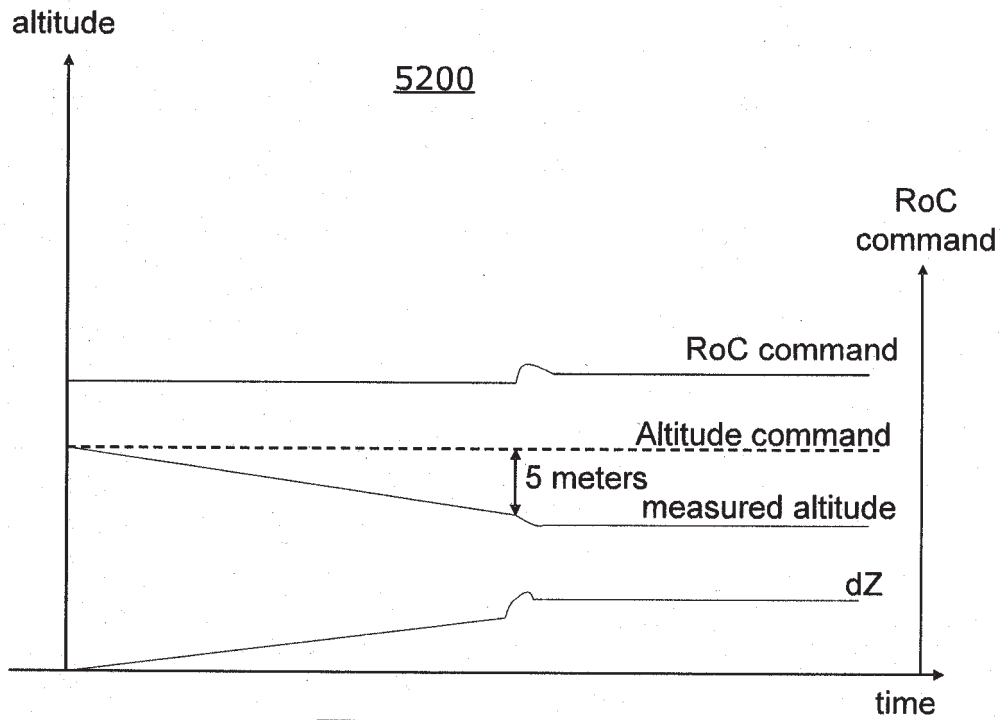
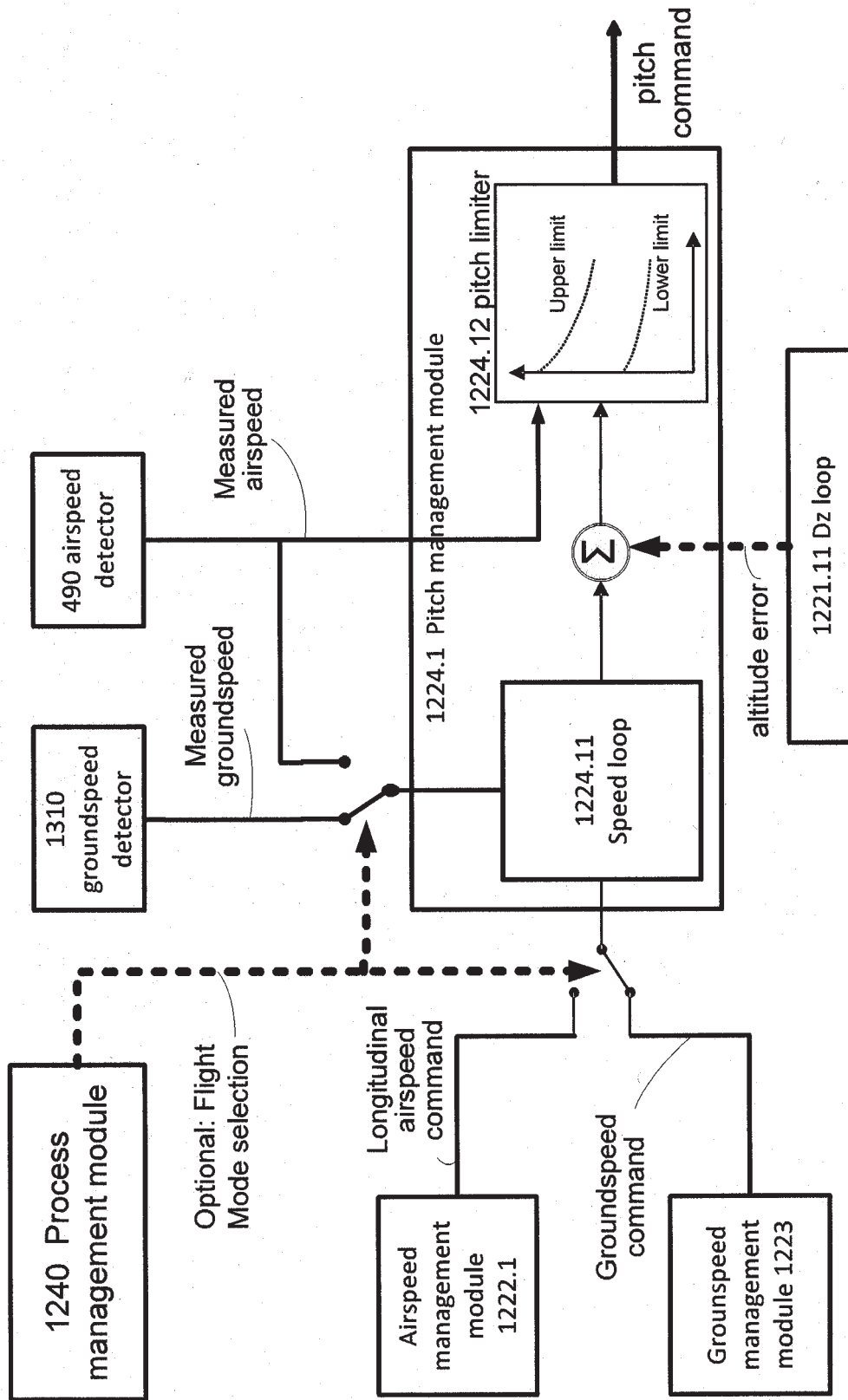


Fig. 16

Fig. 14

## Airspeed / groundspeed / pitch channel



# Altitude (dz) / rate of climb (ROC) / throttle channel

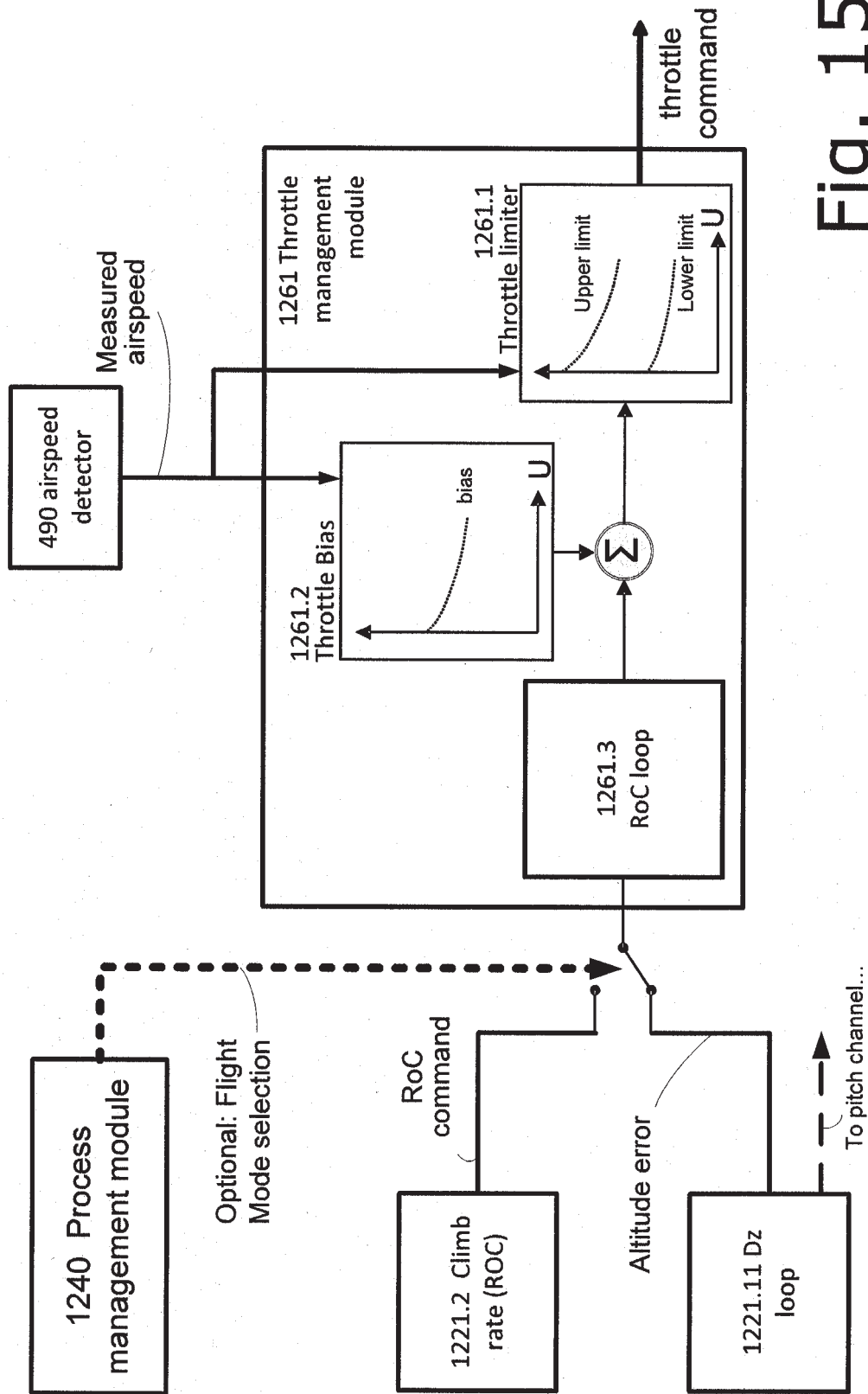


Fig. 15

# Inner loop scheme

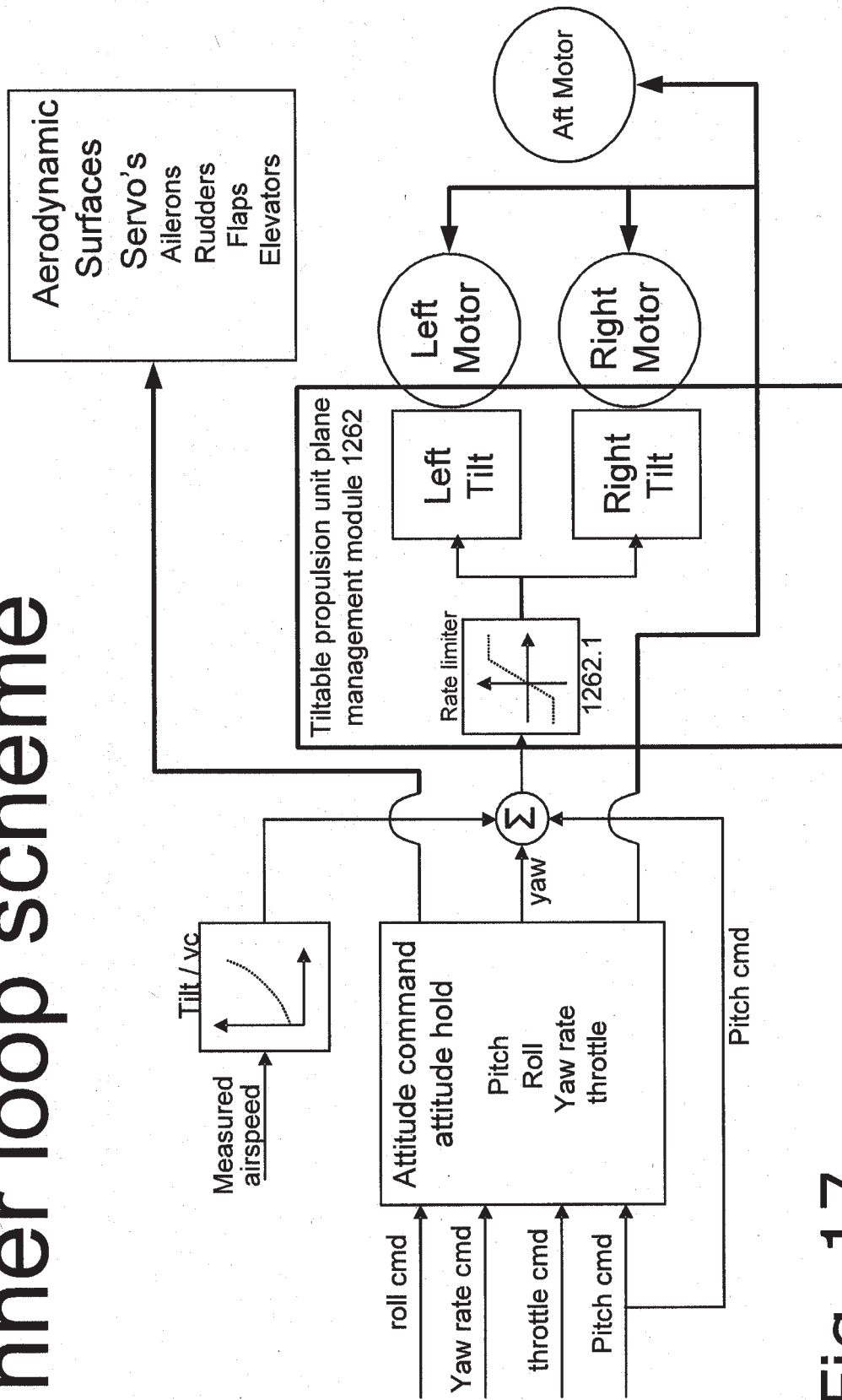
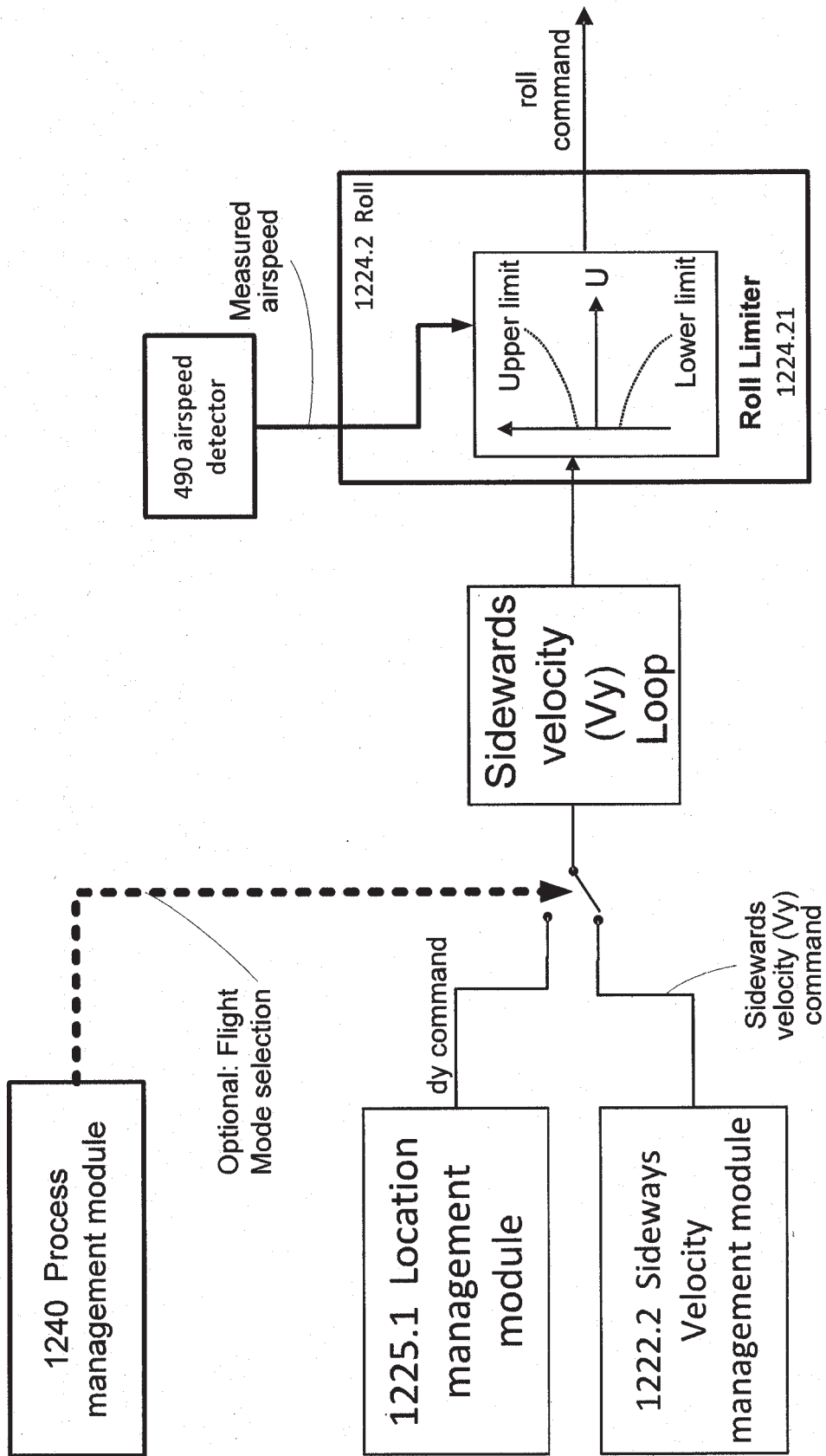


Fig. 17

Fig. 18

dy / sideways velocity / roll channel



|                                                                                                     | Airspeed command module                                                                               | Altitude /RoC command modules                                                                                                                | Heading command module                                                                                                  | Pitch command module                               | Rotor tilt command module                                                          | Throttle command module                      | Stage Transition rule                                              |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------|
| <b>3110</b><br>"Jump up"                                                                            | Focus on keeping fixed Yaw and/or Roll                                                                | Focus on keeping fixed Yaw and/or Roll                                                                                                       | Focus on keeping fixed Yaw and/or Roll                                                                                  | Minimize change to pitch and/or keep horizontal    |                                                                                    |                                              |                                                                    |
| <b>3120</b><br>"Heave up"                                                                           | groundspeed based control. If measured groundspeed is low, keep zero, if higher than freeze it        | Climb according to RoC command, employ limiters                                                                                              | Freeze heading                                                                                                          |                                                    |                                                                                    |                                              | When crossing altitude threshold. Possibly also according to timer |
| <b>3200</b><br><b>Accelerate</b><br>(switching to airspeed control, instead of groundspeed control) | Employ acceleration command. Optionally, Airspeed command freezes if airspeed error exceeds threshold | Either RoC or dZ command, or RoC with dZ override. Optimally: RoC command is zero below an airspeed threshold and fixed above the threshold. | Initially keep heading, when airspeed increases, allow to bring front against the wind (roll is used to keep direction) | Based on airspeed command and on measured airspeed | Based on airspeed command and on pitch command                                     | Based on RoC command and on airspeed command | When crossing airspeed threshold.                                  |
| <b>3300</b><br><b>Transition</b>                                                                    |                                                                                                       |                                                                                                                                              |                                                                                                                         | Pitch, yaw, and roll are preferably froze          | Bring rotors to provide thrust in the general longitudinal thrust vector direction | Switch off before, switch on after           | When rotors are at the correct position                            |
| <b>3400</b><br><b>Climb-out</b><br>/Normal flight                                                   |                                                                                                       | Climb out per RoC or altitude command                                                                                                        |                                                                                                                         | As in the first flight mode                        | Rotors are tilted forward                                                          | As in the first flight mode                  |                                                                    |

Fig. 19

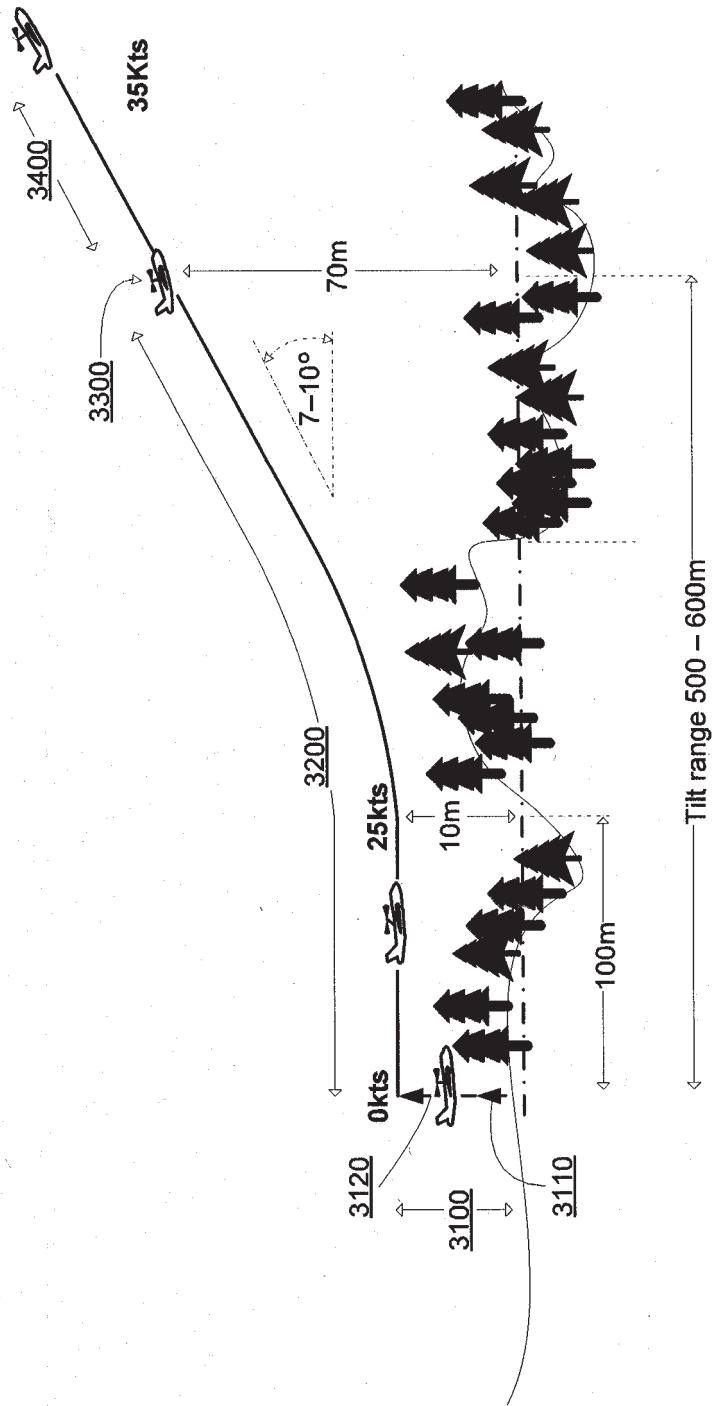


Fig. 20