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MINISTÉRIO DAS OBRAS PÚBLICAS, TRANSPORTES E COMUNICAÇÕES

GABINETE DE PREVENÇÃO E INVESTIGAÇÃO DE ACIDENTES COM AERONAVES

FINAL INCIDENT REPORT

BUFFALO AIRWAYS

CANADAIR CL-215

C-FTXB

Santa Maria Airport

Azores - Portugal

16th of March 2009

GPIAA
Homologo nos termos do nº 3 do artº 26º do D.L. 318/99, de 11/08/1999

18.JUN.2010

O Director,

Fernando Ferreira dos Reis

FINAL INCIDENT REPORT Nr. 10/INCID/2009

NOTE

This report states the technical findings regarding the circumstances and probable causes which led to this incident.

In accordance with Annex 13 to the International Civil Aviation Organisation Convention, Chicago 1944, Council Directive 94/56/EC, 21st NOV 1994, and article 11th nº 3 of Decree-Law nº 318/99, 11th AUG 1999, the sole purpose of this investigation is to prevent aviation accidents. It is not the purpose of any such incident investigation and the associated investigation report to apportion blame or liability.

The only aim of this technical report is to collect lessons which may help to prevent future accidents.

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SYNOPSIS

On the 16th of March 2009, Buffalo Airways, Ltd aircraft, a Canadair CL-215, registration C-FTXB, took off from Santa Maria (LPAZ) airport, at 12:53 UTC[1], heading east to Cascais (LPCS). The aircraft was engaged on a delivery flight to Turkey and was accompanied by another similar aeroplane.

About 80NM far from Sta. Maria the pilot reported an overspeed on engine #1 propeller and that he couldn't control the situation and had to shut down affected engine, requesting to go back to Sta. Maria, where he landed, single engine, at 14:28, uneventfully.

Company technicians were dispatched to Sta. Maria, left engine propeller governor was changed, a test flight carried out and the aircraft resumed its flight to destination on the 30th of March.

This report has been released in Portuguese and English Languages. In case of conflict, Portuguese version will take precedence.

[1] - All times referred in this report, unless other specified, are UTC (Universal Time Coordinated) times. Before March 30, local time in Azores was one hour less than UTC time. From March 30 local time in Azores was equal to UTC time.

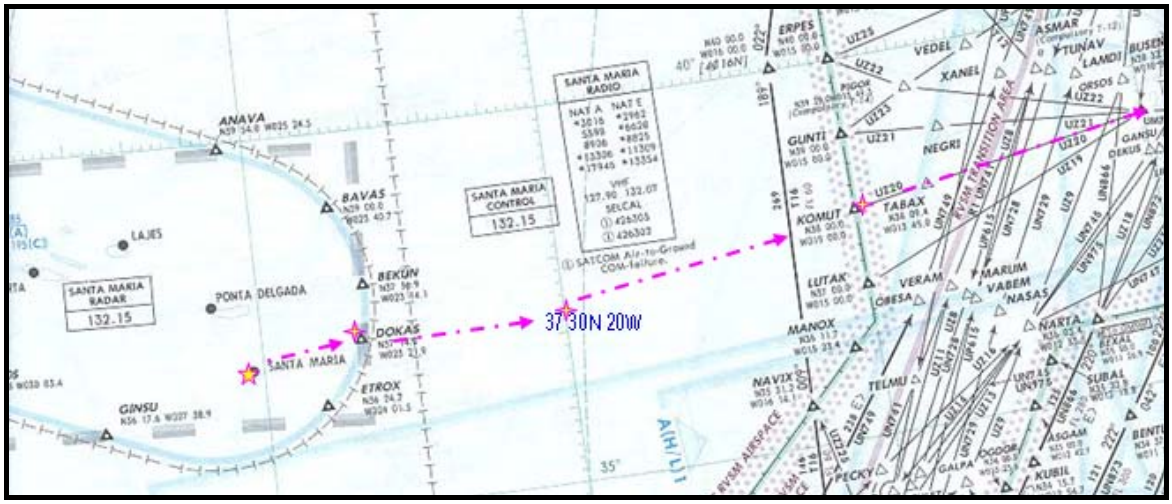
1. FACTUAL INFORMATION

1.1 History of the Flight

Canadair CL-215 aircraft, Canadian registration C-FTXB, has been sold to a Turkish operator and was on a ferry flight for delivery to the new owner, together with another similar aeroplane (C-GFNF).

It flew from Canada to Azores, arriving at Sta. Maria (LPAZ) on the 14th of March 2009, expecting to leave on the 16th to Cascais (LPCS) from where it would continue to Murcia (LELC) and then resume ferry flight to final destination.

At 12:45, on the 16th, the aircraft left LPAZ following submitted Flight Plan via "DOKAS" – "37º30'N 20ºW" – "KOMUT" – "BUSEN" to destination LPCS, flying at an altitude of 9000ft (FL 090) (*picture nr. 1*).



Picture Nr. 1

Taking off, on runway 18, at 12:53, the aircraft followed standard departure to "DOKAS", climbing to FL 090 and proceeding according Flight Plan.

Approximately 50 minutes later, about 80NM far from Sta Maria, engine #1 propeller entered in overspeed that couldn't be corrected by performing recommended checklist and forced the PIC to shut down the engine and return to departure aerodrome.

C-FTXB was cleared to proceed direct to Sta. Maria VOR "VSM" and descend to FL 060. By 14:28 the aircraft landed safely in Sta. Maria airport.

A Company technical team was dispatched to Sta Maria and the aircraft continued to destination on the 30th of March, after #1 propeller governor has been changed and a satisfactory flight test carried out.

1.2 Injuries

Both pilots on board suffered no injuries.

1.3 Aircraft Damage

There was no damage to the aircraft.

1.4 Other Damage

There was no third party damage reported.

1.5 Flight Crew

Flight crew was composed by two pilots (Captain and F/O), with following references:

Reference	**Captain**		**F/O**	
Personal: Sex:	Male		Male	
Age:	53		55	
Nationality:	Canadian		Canadian	
Flight License:	ATPL(A)		ATPL(A)	
Validity:	2009-05-01		2010-06-01	
Last Medical Examination:	2009-01-14		2008-10-15	
Restrictions:	Glasses Worn		Glasses Available	
Flight Experience (Hours**):**	**Total**	**On Type**	**Total**	**On Type**
Total:	11 055	542	14 500	1 000
Last 90 days:	30	30	39	39
Last 28 days:	12	12	17	17
Last week:	11	11	11	11
Last 24 hours:	2	2	2	2

1.6 Aircraft

1.6.1 General

The CL-215 (*picture nr. 2*) was designed as a specialist fire bomber, particularly suited to Canada and other heavily forested regions.

The resulting amphibious aircraft is powered by two 1565kW (2100SHP), Pratt & Whitney R-2800 83AM, 18 cylinder radial piston engines, driving three blade constant speed propellers.

Picture Nr. 2

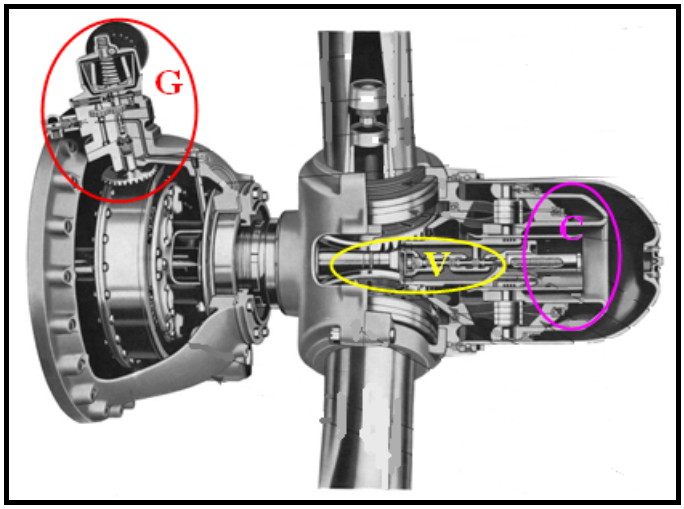
The aircraft carries a flight crew of two, plus accommodation, in special missions, for a third flight deck member, a mission specialist and two observers. In passenger configuration, it has provisions for 30PAX at 79cm (31in) pitch, or, in a combi configuration, for 11PAX with firebombing tanks retained and freight in forward fuselage. Fire retardant payload capacity is 6123kg (13,500lb) and it is capable of scooping up 5455 litres (1440US gal) of water in 12 seconds from a water source.

C-FTXB aircraft had the references shown below and its Certificate of Registration, Airworthiness Certificate, Radio Licence and Insurance were valid at that time.

Reference	Airframe	# 1 Engines # 2		# 1 Propellers # 2	
Manufacturer:	Canadair	Pratt & Whittney		Hamilton Standard	
Model:	CL-215	CA3 CB16/17		43E60-701	
Serial Nr.:	1007	P34607	P36641	N194187	N19265 583
Flight Time:	44298	N/A	N/A	N/A	N/A
Landings / Cycles:	N/A	N/A	N/A	N/A	N/A
Last Inspection:	N/A	N/A	N/A	N/A	N/A

1.6.2 Propeller System Design & Operation

1.6.2.1 Main Principles



Picture Nr. 3

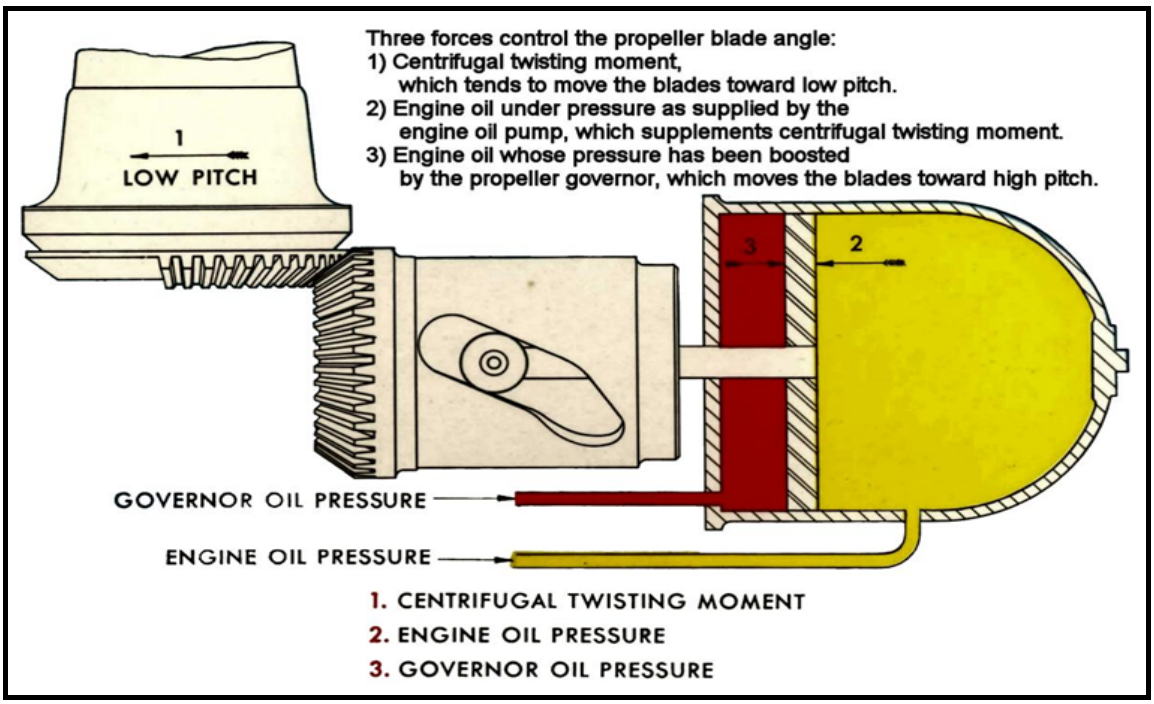
Hamilton Standard 43E60 three blades variable pitch propellers were installed on this aircraft.

Its construction follows the same principle as the one shown on picture nr. 3 (on the left) and they are controlled by a hydro mechanical system that provides a full range pitch control from fine pitch to feather.

The brain of the system is the *Governor* "**G**", which sends oil pressure through *Distributer Valve* "**V**" to the *Actuating Cylinder* "**C**", in order to keep propeller speed inside the RPM range selected.

The forward movement of the actuating cylinder causes the blades to increase pitch, while its rearward movement causes the blades to go towards a lower pitch angle. These

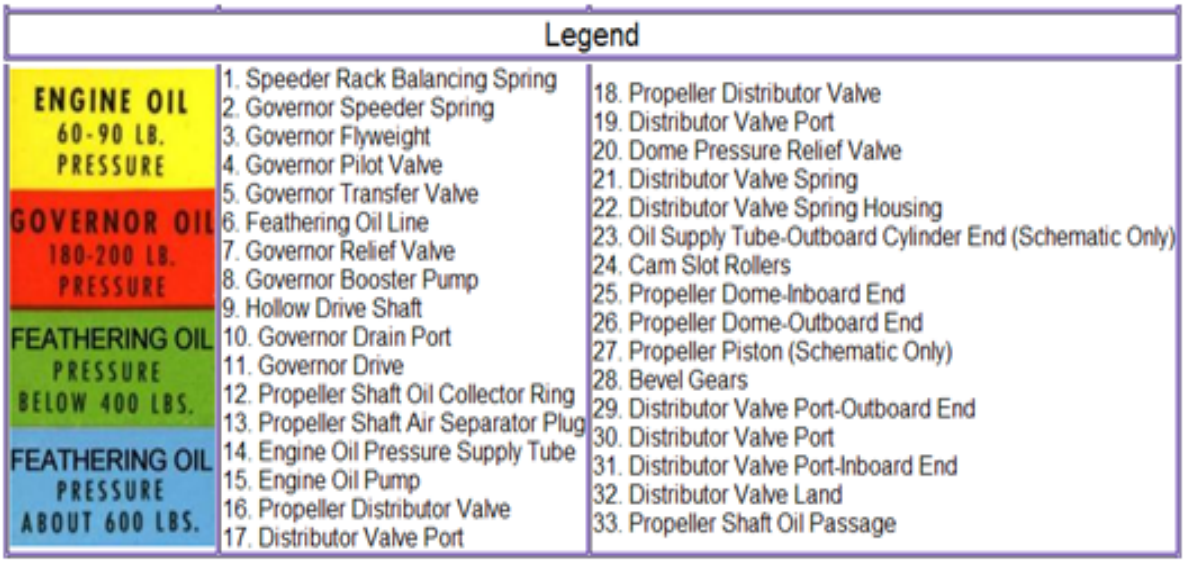
changes are mechanically performed, through a cam & pinion mechanism, under the influence of three main forces (*picture nr 4*).



Picture Nr. 4

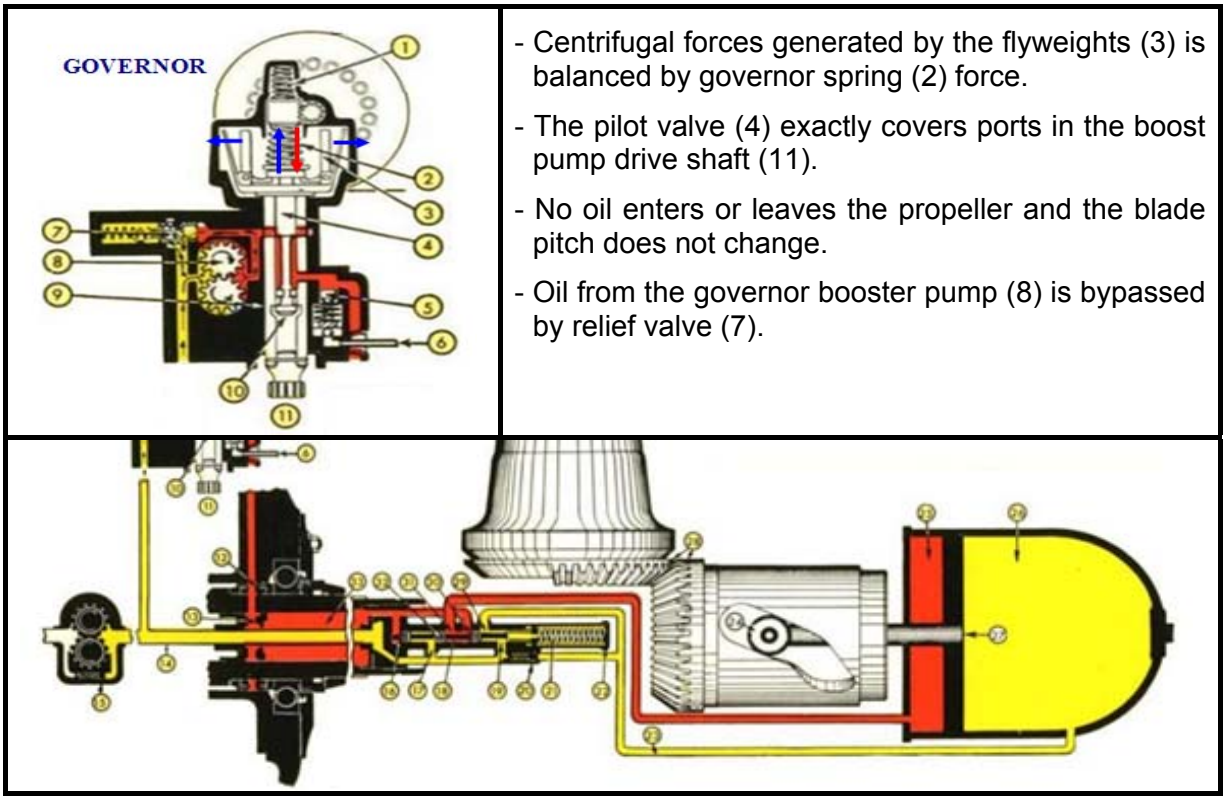
In following steps we will remember how the whole system operates and how propeller constant speed control is achieved.

For that let's make use of manufacturer diagrams, whose legend is shown bellow (*picture nr 5*), covering all phases of operation, from onspeed, overspeed, underspeed, feathering and unfeathering.



Picture Nr. 5

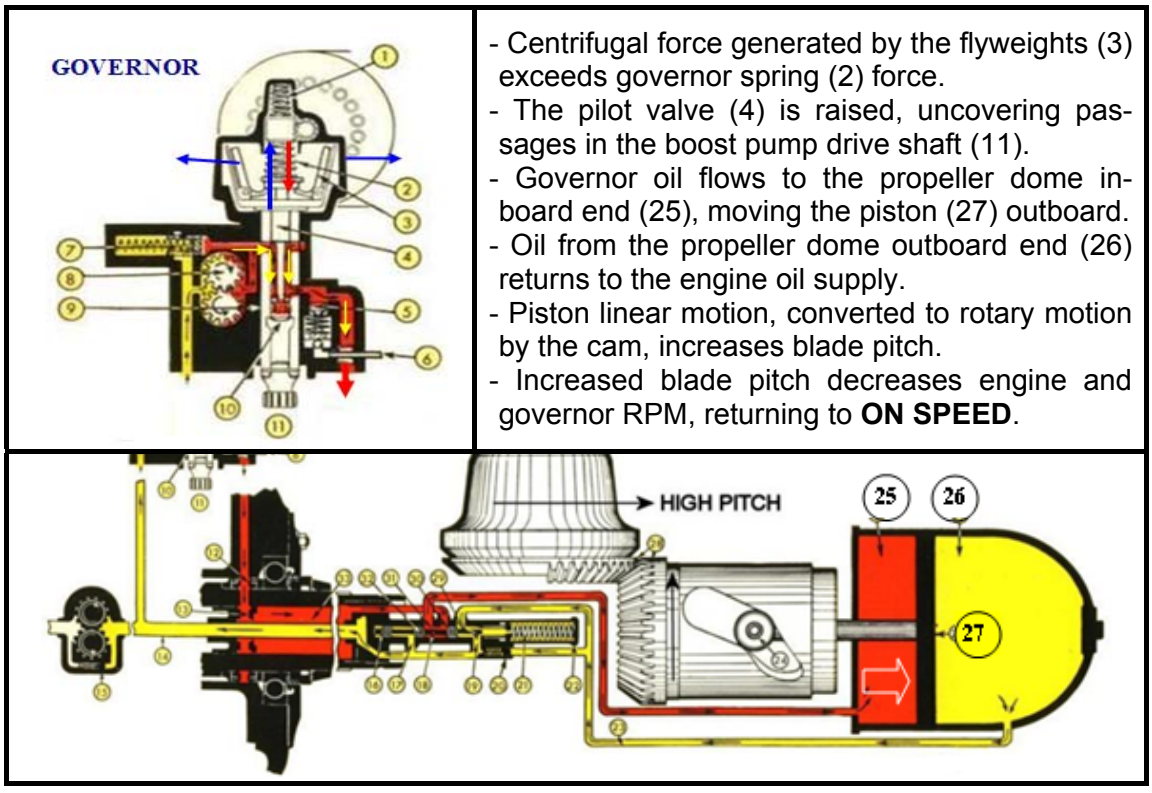
1.6.2.2 On Speed Operation



- Centrifugal forces generated by the flyweights (3) is balanced by governor spring (2) force.
- The pilot valve (4) exactly covers ports in the boost pump drive shaft (11).
- No oil enters or leaves the propeller and the blade pitch does not change.
- Oil from the governor booster pump (8) is bypassed by relief valve (7).

Picture Nr. 6

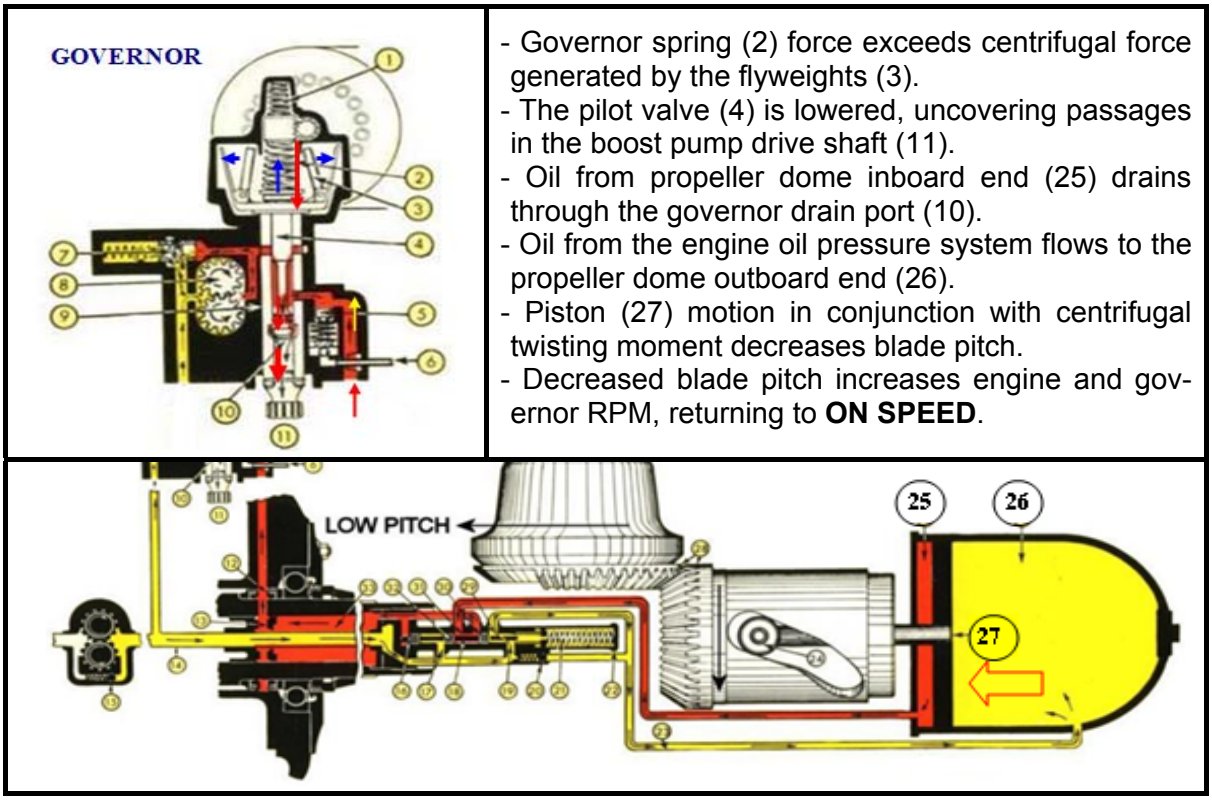
1.6.2.3 Overspeed Control



- Centrifugal force generated by the flyweights (3) exceeds governor spring (2) force.
- The pilot valve (4) is raised, uncovering passages in the boost pump drive shaft (11).
- Governor oil flows to the propeller dome inboard end (25), moving the piston (27) outboard.
- Oil from the propeller dome outboard end (26) returns to the engine oil supply.
- Piston linear motion, converted to rotary motion by the cam, increases blade pitch.
- Increased blade pitch decreases engine and governor RPM, returning to **ON SPEED**.

Picture Nr. 7

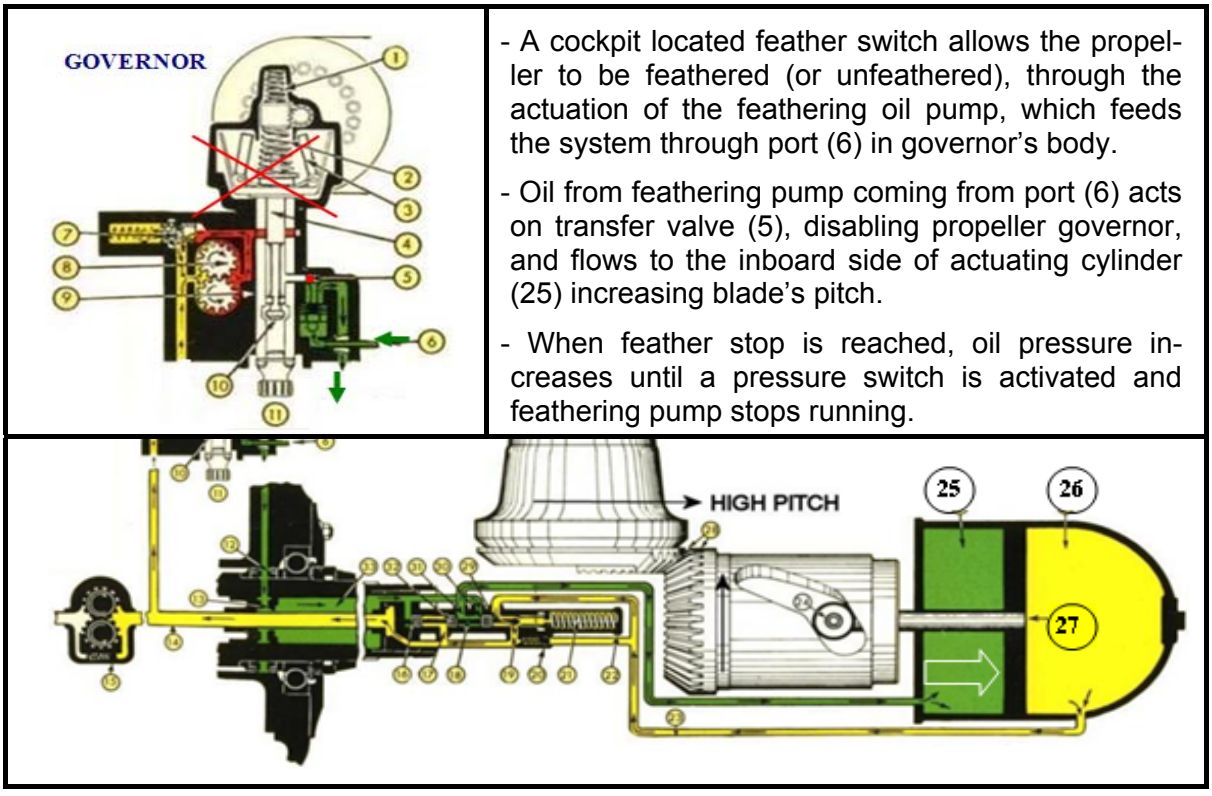
1.6.2.4 Underspeed Control



- Governor spring (2) force exceeds centrifugal force generated by the flyweights (3).
- The pilot valve (4) is lowered, uncovering passages in the boost pump drive shaft (11).
- Oil from propeller dome inboard end (25) drains through the governor drain port (10).
- Oil from the engine oil pressure system flows to the propeller dome outboard end (26).
- Piston (27) motion in conjunction with centrifugal twisting moment decreases blade pitch.
- Decreased blade pitch increases engine and governor RPM, returning to **ON SPEED**.

Picture Nr 8

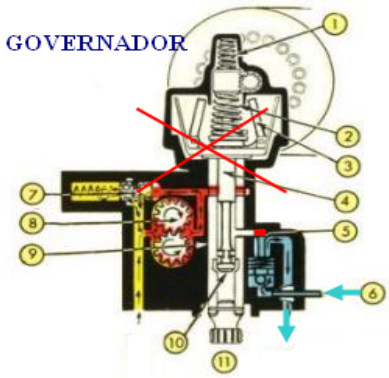
1.6.2.5 Feathering



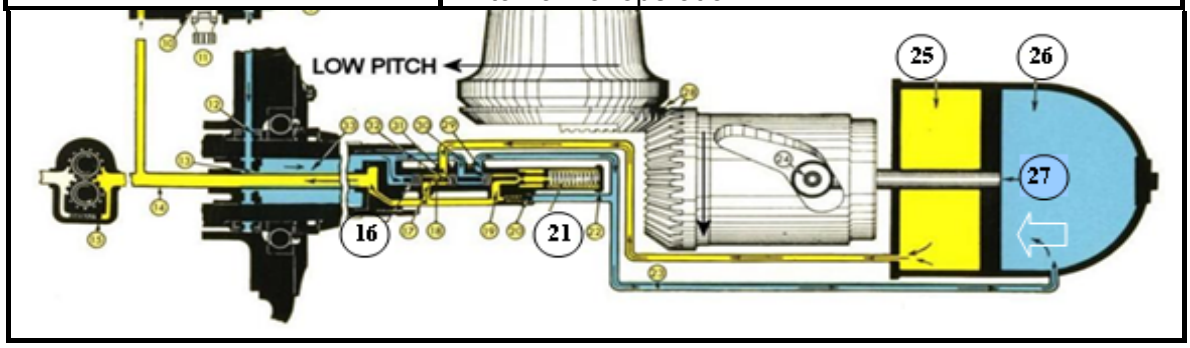
- A cockpit located feather switch allows the propeller to be feathered (or unfeathered), through the actuation of the feathering oil pump, which feeds the system through port (6) in governor's body.
- Oil from feathering pump coming from port (6) acts on transfer valve (5), disabling propeller governor, and flows to the inboard side of actuating cylinder (25) increasing blade's pitch.
- When feather stop is reached, oil pressure increases until a pressure switch is activated and feathering pump stops running.

Picture Nr. 9

1.6.2.6 Unfeathering



- To unfeather the propeller the same feathering pump is used to pressurize the system through port (6).
- Feather stop pressure switch is overridden by maintaining feathering pump switch pressed until oil pressure reaches around 600psi and distributer valve port (16) pressure overpasses the spring (21) force, deviating the feathering pump oil flow to outboard side of actuating cylinder.
- Cylinder backwards movement causes the blades to leave feather position and decrease pitch, returning to normal operation.



Picture Nr. 10

1.7 Meteorology

It was a sunny day with a moderate to strong wind, blowing from 120º at 17kts, visibility more than 10km, few clouds at 600ft, scattered at 1500ft, temperature 18ºC, dew point 16ºC and QNH 1012 hPc.

1.8 Navigation Aids

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome

Not applicable.

1.11 Flight Recorders

The aircraft was not equipped with flight recorders.

1.12 Wreckage & Impact

Not applicable.

1.13 Medical or Pathological

Not applicable.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Not applicable.

1.16 Tests & Research

Left engine propeller has been installed on C-FTXB on April 22, 2004 with 00:00 TSO. On March 14, 2009 it had accumulate 341.7 hours TSO. The removed propeller governor (s/n WH 91780) was sent to "AVIATION B. L. inc." for test. Inspection work report referred:

"Governor was found full of thick sludge preventing correct operation of spool valve plus at O/H the body p/n 321898 was found cracked".

The reason for such sludge accumulation was not referred on the report but we may presume that exposition to elements, together with a lack of maintenance care, could be the main cause.

1.17 Organizational & Management

Information on operator's organization & management was not provided and no information on company operations and maintenance procedures has been collected.

1.18 Additional Information

There's no other relevant information to refer.

1.19 Investigation Techniques

No special investigation techniques were used for this investigation. All evidence was collected from official documentation and "Aviation B. I. inc" test report.

2 ANALYSIS

2.1 C-FTXB #1 Propeller Behaviour

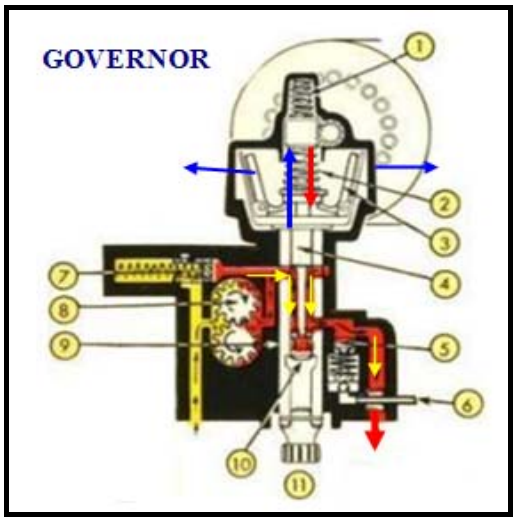
2.1.1 Expectancy

During climb, blade pitch was low. When the aircraft reached assigned flight level, engine power and blade pitch was selected for cruise conditions.

Propeller load decrease, after level off, would increase engine & propeller RPM.

In consequence, flyweights (3) generated centrifugal force would surpass governor spring (2) force and lift pilot valve (4), allowing governor oil pressure to flow to inboard side of propeller dome, moving the piston outboard and increasing blade pitch.

Blade pitch increase would put more loads on the engine and RPM should decrease, returning to normal operation (**onspeed condition**).



Picture Nr. 11

2.2.2 Reality

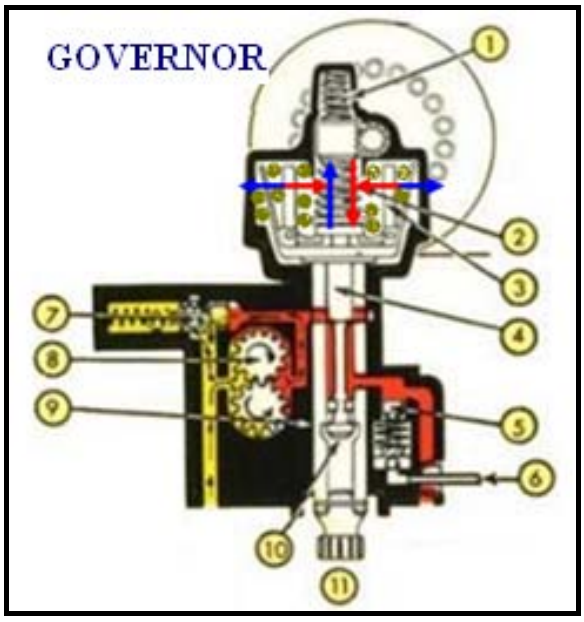
When the aircraft reached assigned flight level engine power and blade pitch were selected for cruise conditions.

Aircraft speed increasing reduced propeller load and caused an increase of engine and propeller RPM.

Engine and propeller acceleration should increase centrifugal force of flyweights and raise the pilot valve, bringing the system to onspeed condition.

The presence of dirt and other contamination material in the body part prevented the pilot valve to be raised by flyweight's centrifugal force (*picture nr 12*).

Engine acceleration increased engine oil pressure acting on outboard (forward) side of actuating piston.



Picture Nr. 12

Engine oil increased pressure delivered to forward side of actuating piston, added to blade twisting moment, surpassed blocked governor oil pressure in rearward side of actuating piston and moved propeller blades to a smaller pitch angle, thus increasing propeller and engine RPM.

Such increase on engine RPM exceeded acceptable limits, affecting engine's performance and risking engine damage.

To avoid engine damage the pilot had to switch off the affected engine and feather respective propeller, which could be accomplished without pilot valve actuation (*see 1.6.2.5*).

With single engine operation, the best course of action was to return to departure airfield, which pilot did.

3 CONCLUSIONS

3.1 Findings

1st The flight was authorized and all requirements have been fulfilled;

2nd The crew was duly qualified and acted accordingly;

3rd The aircraft was airworthy, all certificates were valid and there were no reports of any malfunction, restriction or limitation to aircraft operation;

4th After stabilized in cruise, left engine propeller increased its speed, reaching over-speed limits, without reaction to pitch control procedures performed by the crew;

5th The crew decided to shut-down left engine and feather respective propeller, returning to departure aerodrome;

6th One engine inoperative landing in Sta Maria was uneventful;

7th Left propeller governor was removed and a new one installed, allowing the aircraft to continue to its final destination;

8th Tests carried out on the removed propeller governor detected cracks on governor body and sludge have been found inside, which prevented normal operation of pilot valve, thus restricting left propeller pitch control.

3.2 Causes of the Incident

The aircraft made a flight return to departure aerodrome because engine #1 had to be shut-down in flight and respective propeller feathered, due the uncontrollability of propeller blade's pitch angle during cruise flight, which entered in overspeed.

That uncontrollability was presumably due to the existence of sludge inside #1 propeller governor body, which prevented the pilot valve to be lifted and to allow governor oil pressure to be directed to inboard side of moving piston, in propeller pitch control mechanism, increasing blade pitch angle and reducing RPM.

4 SAFETY RECOMMENDATIONS

Considering that an appropriate maintenance programme should be able to avoid, or detect and timely correct, any deviation from normal performance or other abnormality on any system or aircraft part, a safety recommendation should be issued, calling for an assessment of Buffalo Airways maintenance procedures and possible improvement.

After being informed that Canadian Civil Aviation Department (Transport Canada) generated CADOR[2] 2009C0714 and maintenance Inspectors began a follow up with Buffalo Airways, Ltd, on Mar 26, 2009, intended safety recommendation became no more relevant.

Consequentially, there are no Safety Recommendations issued.

Lisbon, 11th of June, 2010

The Investigator In Charge,

António A. Alves

[2] - Civil Aviation Daily Occurrence Report