JPRS L/9979

11 September 1981

West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 10/81)

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APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000400050029-1

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SCIENCE POLICY

RESEARCH MINISTER REVEALS BROAD OUTLINES OF FUTURE ACTIONS

Paris AIR & COSMOS in French 18 Jul 81 p 9

[Article by Pierre Langereux: "Toward a Big Ministry of Research"]

[Text] Research Minister Jean-Pierre Chevenement, a guest of the Association of Science Journalists on 8 July, revealed the broad outlines of his future actions, which will be centered on three primary efforts:

--"building" the (big) Ministry of Research and Technology announced by the government and entrusted to Jean-Pierre Chevenement, minister of state;

--preparing the 1982 research budget, on which a budget meeting is to be held shortly to firm up the guidelines, which will obviously be difficult, considering the substantial increase in appropriation requests and the rise in the rate of inflation (+14 percent forecast in 1981);

--and organizing for January 1982 a nationwide research and technology symposium to "establish the objectives and constituent elements of the science and technology policy, the development of which must be a top priority task."

Preparing the Program Statute

The symposium, for which the national organizing committee is now being formed under the chairmanship of Prof Francois Gros, director of the Institut Pasteur, will be prepared by "regional sittings" which are to be held from 1 October through 15 November 1981. These sittings must submit their synthesized reports by 20 December 1981.

This symposium will serve especially to prepare the future Program Statute on Research and Technological Innovation (1982 through 1985-1986), which is expected to be voted on by the National Assembly at its spring 1982 session and which is to be included in the Temporary 2-Year Plan (1982-1983).

This Program Statute will have as its objective, already announced by the president of the Republic, a national research and technology effort--civil and military--equal to 2.5 percent of the GNP (gross national product) in 1985. This will mean a progression from Fr 53 billion* to Fr 80 billion over a period of 4 years, hence a very rapid rise in research appropriations--at the rate of around 11 percent annually, not considering inflation!

The priorities under this program statute, which are to be defined over the next several weeks in consultation with national committees, will center mainly on microelectronics, robotics, biotechnologies, and new energies, according to Jean-Pierre Chevenement.

Program Contracts

First, it will be necessary to settle certain "problems of coordination" between the scientific research activities that now come under the Ministry of Research and the other research activities--military, telecommunications and civil aeronautics--which are not yet in Mr Chevenement's province.

It is a matter therefore of redefining the content of the famous "research envelope," which the new minister considers "relatively ineffective," which would be replaced by "program contracts" (or plans), and to which the president of the Republic has previously made reference.

This will also necessitate the defining of the duties and responsibilities of the Ministry of Research with respect to the overseeing of certain major organizations such as the AEC [Atomic Energy Commission], CNES [National Center for Space Studies], CNEXO [National Center for Exploitation of the Oceans], CNET [National Center for Telecommunications Studies], etc.; as well as the future of other more recent organizations such as the COMES [Solar Energy Commission].

Jean-Pierre Chevenement stated that the decrees defining the functions of the minister of research should be forthcoming in a matter of days.

Dual Oversight of CNES

The decree stipulating responsibilities for oversight of the CNES--Jean-Pierre Chevenement indicated--was enacted on 17 June by the Council of Ministers and signed by all those concerned (prime minister, ministers of research, finance, etc), except the minister of industry.

This decree provides that the CNES budget will be entirely a part of the Research Ministry's budget (whereas previously, it was part of that of the Ministry of Industry), and that administrative oversight will be divided between the Ministry of Research for the CNES strictly speaking, and the Ministry of Industry for oversight of the CNES subsidiaries of a more industrial or commercial nature, such

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* Total 1981 appropriations, which included Fr 13.5 billion for basic and applied civil research, Fr 11 billion for military research, Fr 6.5 billion for major technological programs, and Fr 22 billion for industrial research (Fr 5.6 billion for nationalized industry, Fr 7.2 billion for the "nationalizable" sector, and Fr 9.2 billion for the private sector).

as Arianespace (production and marketing of Ariane rockets), SPOT-Image (production and marketing of SPOT [Earth Observation Probe System] images) and Satel-Conseil (telecommunications and TV satellite consultations).

Oversight of CNEXO will also be divided this time among three ministries: Research, Industry and Seas.

As for COMES, its future has not yet been decided. A ministerial group is being formed to take stock of solar activities in France and to study the structure best suited to pursue the research and development effort in this domain.

The minister of research also proposed the creation of a Parliamentary Committee on Technological Alternatives.

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CSO: 3102/369

TRANSPORTATION

CONFERENCE ON ADVANCED MATERIALS IN AEROSPACE INDUSTRY

Paris AIR & COSMOS in French 18 Jul 81 pp 18-19

[Article by Yves-Ernest Grandvalet: "Technological Advances in Special Steels and Alloys"]

[Text] As a traditional adjunct of the Bourget Air Show, a conference was held on "Special steels and alloys in the aerospace industries." It again was a great success (with around 240 participants) to the point that it could conceivably take on an international dimension. The conference provided an opportunity to hear some very informative talks by Mssrs. Roger Chevalier (SNIAS [National Industrial Aerospace Company]/GIFAS [expansion unknown], Hilaire (SNIAS), Brunetaud (SNECMA [French National Aircraft Engine Company], Payne (Creusot Loire), Elghozi (Societe Commentryenne des Aciers Fins [Commentry Fine Steels Company]), Devillard (CENG [Grenoble Nuclear Research Center]), Papier (Aubert et Duval), and Rabinovitch and Khan (Onera [National Office for Aerospace Studies and Research]). M Auvinet, chief of the Materials Section of STPA [Public Air Transport Company], summed up the conclusions to be drawn from the workshop.

Hilaire's talk served to put the utilization of the various materials in perspective. The information indicated that steel benefits from the most favorable position, since steel is only to a small degree directly threatened by the composite materials (in contrast to the situation for lightweight alloys) and is even in a position to regain favor as a result of strains in the availability of titanium. Titanium meanwhile ought to regain lost ground now because of stabilization of the market and introduction of new production techniques (casting, powder metallurgy, superplastic forming, diffusion brazing); moreover, titanium has the advantage of coexisting amicably with composite materials (cf. accompanying table).

Respective Proportions (%) of the Various Aeronautic Materials

	Lightweight Alloys	Steel	Titanium	Composites
Airbus A 310	76.5	13.5	4.5	5.5
Boeing	82	13	4	1
Boeing 767	81	14	2	3
Future airplanes	53-75	13	4	8-30
Dauphin helicopter	59	15		24
Future helicopters	50	13-15		30-35

Focusing on engines, Buunetaud's lecture emphasized the advances occurring with better production techniques (isothermal forging, involving deformation of the metal at set temperature and rate; casting of turbine blades by directional solidification; precision casting) which coupled with other economic advances (recovery and recycling of scraps, for example) offer some appreciable cost savings and quality improvements.

Especially for titanium alloys in temperature intervals below 400-450°C, the development of powder metallurgy gives every indication of a promising future.

Organic matrix composites are beginning to have important applications below about 200-250°C. In the high temperature ranges (above 400-450°C), the nickel-base alloys and, to a lesser degree, the austenitic refractory steels are used almost exclusively, though with some prospect for development of higher-performance alloys fabricated by the new technologies, including directional solidification and powder metallurgy.

The cobalt-base alloys (though considered extremely expensive) are hard to replace in very-high-temperature applications (HS 25 through HS 31). For applications at intermediate terperatures, the alloys such as Waspalloy or C 263 with 17-20 percent cobalt have been replaced by Inco 718, particularly for compressor and turbine disks.

As for ceramics, in the near term they can be considered for some nonmajor static parts, and probably ceramic composites will be able to offer more attractive prospects.

The ESR Process

The ESR [Electroslag remelting] process used by Creusot Loire has undergone a rather substantial expansion in recent years, thus responding to the increased demand for quality metal in aeronautics. The lecture delivered by Rayne took stock of a metallurgical survey based on a substantial amount of information, with particular attention to information on the vital assemblies of the Airbus, such as engine support strut parts made of 40 CDV 12 steel and undercarriage parts made of 35 NCD 16-(THQ) steel.

A very strict control of all fabrication variables, from preparation of the casting pattern to remelting under slag, has enabled series fabrication to be achieved with a level of quality which formerly could only be attained with the process of remelting under vacuum (VAR [vacuum arc remelting]). Rayne enumerated the devices in ESR furnaces of the Pamiers plant which make it possible, without changing the electrode, to produce three types of ingots in weights of 4-10 tons and 26 tons, with the further possibility of bringing the latter type (with a diameter of 1.1m) to a size of 33 tons by changing the electrode during the remelting process. Finally, it was pointed out that the "very high quality" (THQ) version of the ESR process was introduced with 35 NCD 16 steel originally to produce the principal parts of the Concorde undercarriage and later was also used for the undercarriage of the Airbus A300; the purpose of the new developments in ESR remelting was to attain the THQ level in a simple remelting operation. The goal was achieved, as indicated by the designation "35 NCD 16-THQ-ESR" for the metal used in stamping out the landing gear wells for the Airbus A310 on a 65,000-ton Interforge press.

It should also be mentioned that automatic control giving perfect reproducibility of the ESR remelting process was provided by computer, integrating the various parameters of operation. Rayne concluded by indicating that at present about 100 ESR remelting runs on 35 NCD 16-THQ have been completed. Today, the French industry can congratulate itself on having developed a very high quality alloy, a direct outgrowth of the Concorde effort, as Auvinet mentioned in his remarks.

Sheet Metal

Sheet metals made of refractory alloys are utilized largely in the manufacture of turbine engines for the combustion chambers, shrouds, nozzles, vanes, etc., in the form of welded assemblies designed for exposure to high temperatures.

In the course of the last two decades, the means for melting and refining have made considerable progress, permitting an improvement of quality and a reduction of cost price. In France, the Isbergues plant has equipment for forming stainless steel sheet metal and laminating it to provide structural stiffening. The plant is also equipped fcr cold lamination of foils consisting of sheets welded and to end.

As concerns the sheet metals made of refractory alloys, the French market, relatively weak and dispersed over a great variety of grades and dimensions, does not justify the installation of continuous lamination equipment.

The Commentary plant is equipped to perform cold lamination operations on a Senzimir mill on a sheet-by-sheet basis, a mode of fabrication which permits the plant to handle lamination of all the types of sheet metal presently used in the most modern turbine engines. The type designations in this category include Rene 41, Astroloy, Waspalloy, and C 263.

By comparison to the U.S. market for refractory alloys (30 times larger than the French market), there nevertheless exists a similarity in terms of the means of fabrication between the Pittsburgh plants of the Universal-Cyclops firm (fourth largest U.S. producer) and the Commentry plants; according to Elghozi, this similarity means that the quality and cost price are entirely comparable, and he concludes that the Societe Commentryenne process is competitive provided the quality [sic; perhaps quantity is meant], format, or qualities are such as to preclude mass production, notably in situations involving grades of alloys which are difficult or even impossible to process by hot lamination in coils.

Powder Metallurgy

The difficulties of supply, the increased production costs, and the substantial coke rates (capable of reaching 20 kg/ton in certain cases) are the principal reasons for the well-developed effort in France to use powder metallurgy in the production of parts made of titanium alloy. This process was developed by CENG with the contributory participation of government agencies.

Powder metallurgy, which promes substantial economies of material, is expected to assert itself if three conditions are met:
--lowering the costs of powder manufacture to equal the costs for forged bar,
--developing more productive shaping cycles to partly reduce capital outlays,
--improving the structure of the sintered products using thermal treatments,

to render the structure less sensitibe to the almost inevitable contamination in the course of manipulation and bring the performance to the same level as cast-forged alloys.

Devillard of CENG described six different processes for producing titanium alloy powders from prealloyed ingots. The three main processes--REP (United States), EBRD (West Germany), and PSV (France)--use spinning electrode methods; the atomization is carried out under argon or helium in the REP process and under vacuum in the PSV and EBRD processes.

The preparation of powders on the industrial scale by atomization under vacuum holds forth the promise of substantial economies in use of hot isostatic pressing to fabricate compressor disks or parts of complex forms (such as the rods or ribs of airframes) with greater blanking precision.

Devillard completed his talk with a presentation concerning an industrial production unit based on 1000 tons of titanium alloy powder per year per station. With such a unit it would be possible to cut the coke rate for parts made of cast-forged titanium alloys by a factor of two for engine parts and by a factor of 3.5 percent of the price of the equivalent piece made of cast-forged titanium alloy.

Devillard concluded by emphasizing the present state of acquired knowledge, which from his point of view constitutes a factor favorable to the industrial promotion of this new way of processing titanium alloys:
--the powder can be supplied at the price of the rolled bar by setting up a production unit with a capacity of 100 tons per year;
--sintering by hot isostatic pressing permits deformations to be controlled; certain reference surfaces can be produced "to dimensions" by perforing the pressing against reusable mandrels or anvils;
--today, by more rigorous quality control for the powder before it is placed in containers, the scatter of the oscillation fatigue test data can be reduced and the characteristics of rolled alloys can be reproduced with a variance of ± 10 percent about the mean value;
--in the aeronautic industry (for airframes and engines taken together) it is possible to achieve savings on the order of 50 percent in materials and 35 percent in fabrication costs.

Elements Used for Assembly

Papier, of the Aubert et Duval firm, drew attention to various aspects of fabrication and quality control in regard to materials for welding and nuts, bolts, and screws, calling attention to the continual and necessary overlap of operations for "Quality and Quality Assurance" in the manufacturing procedures. In discussing nuts and bolts, Papier dealt more specifically with problems of bolts obtained by final hot transformation compared to those obtained by cold die forging. The "hot" bolts are produced from age-hardening austenitic alloys (type Z 6 NCTDV 25-15 grades and superalloys of the Nimonic, Udimet, Waspalloy, and Incot 18 types).

Papier ended his talk by touching on the very important subject of quality in the domain of assembly by welding, for which Albert et Duval manufactures wires in coils or uncoated rods in diameters between 0.8 and 3mm. This area also includes various grades of martensitic steels, austenitic stainless steels, alloys, and superalloys.

Forces and Challenges

In his concluding remarks, Auvinet set forth both the strong points of the French industry and the challenges which are now facing it. In this spirit, particular attention was given to France's development of both 35 NCD 16 steel (a by-product of the Concorde effort) and powder metallurgy of titanium, for which the community has high hopes. Equally interesting is the work of Onera on Cotac and the oriented eutectics in particular. (Onera's work, particularly on Cotac 74 and 744 and on the oriented eutectics, which was treated in another context at the Bourget Air Show merits separate treatment in major articles, which we will include in an upcoming issue of AIR & COSMOS.) The discussion dealing with Onera, however, put the emphasis on the important role played by public institutions and government agencies in these developments.

In the category of challenges, we will include under this label various technological changes cited by Auvinet. First, there are the composite materials, which are already serving as a stimulus to the producers of lightweight alloys, such as in the direction of developing lithium-aluminum alloys. Next, there is the challenge of other technologies such as directional solidification, oriented eutectics, and single crystal methods applicable to the fabrication of turbine blades. Finally, Auvinet stressed the advances in ceramic composites, which could turn the world of metallurgy topsy turvy.

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CSO: 3102/370

TRANSPORTATION

DUTCH MINISTER INTERVIEWED ON CIVIL AERONAUTICS

Paris AIR & COSMOS in French 18 Jul 81 pp 8-9

[Text] Mr G. M. V. Van Aardenne, minister of economic affairs of the Low Countries, who heads civil aeronautics construction financing, was good enough to grant our editor-in-chief an interview, during which he discussed the position of the Dutch authorities in this domain.

An Important Industry for the Low Countries

Mr Van Aardenne first explained, by way of introduction, the importance the Dutch authorities attach to civil aeronautics construction. For the Low Countries, which have a heavy industry but which are seeking more high-technology industry, aeronautics provides an especially apt response to this need because it is an industry whose energy requirements are relatively low. The experience of its engineers and technicians places Holland in an equally apt position to participate in this activity, which is capable of attracting private capital provided these investments are backed by adequate state loans.

To our first question, regarding the aid provided by the Dutch government to civil aeronautics construction, Mr Van Aardenne replied that it is a policy that has been followed over approximately the last quarter century, first with respect to the F 27 Friendship, then, the F 28 Friendship. The F 27, the developmental funding of which was only partially underwritten by the Hague government, sold well and has continued selling well. Currently, it is a profitable program. The government's aid has been reimbursed. Sums thus recovered are placed in a revolving fund used for the financing of new developments.

An identical method was used for the F 28. Development costs were much higher than for the F 27 and sales are less advanced. This project has not yet reached the profitability threshold, but expectations of attaining this objective are still alive.

The Dutch authorities consider the experience gained from these two projects to have been positive. They are all the more intent upon pursuing this experience in that, unlike the case of most countries that have an aeronautics industry, Dutch industry is not being called upon to develop military planes of Dutch design; its manufacturing activities, which are far from negligible, are devoted to the production of materiel of foreign design. The Dutch authorities are also very intent upon pursuing a national policy of design, production and marketing of civil transport planes, a policy being carried out by private industry but being actively aided by the state.

From the F 29 to the MDF 100

An approach identical to that used in the case of the F 27 and the F 28 was therefore adopted for the F 29 project--which was the subject of our second question--it being understood, of course, that the order of magnitude of the latter is quite different from that of the F 27 and F 28 and that, from the outset therefore, Fokker could not expect to undertake the project alone. Two and one-half years ago, during the negotiations on the Atlantic program, the Dutch authorities contacted the French authorities to suggest the study of a joint project designed to maintain cooperation between the two countries. Unfortunately, agreement could not be reached on the 150-seat airliner program.

The exchange of views between the two governments continued, however; and as a result, the Dutch authorities agreed to back Fokker's cooperation in the Airbus program, with Fokker taking part in the A 300/310 programs and extending this cooperation to the A 300-600.

The Airbus program alone, however, does not enable the Netherlands government to fully attain its objective, which is an entirely national civil transport plane design, production and marketing industry. The government has therefore decided to back the F 29 conceptual phase, which initially was to end this spring but is now extended by way of the MDF 100 project to, and indeed a little beyond, the end of this year. Fokker must seek partners to share in this phase, and it was in accordance with this requirement that a memorandum of agreement was signed with Mc Donnell Douglas under which the two partners hold equal shares in the project. Mr Van Aardenne pointed out that this basic agreement does not preclude the signing of other cooperative agreements. The Dutch government has also required that the project be of a very advanced technology and that it not be actually launched until agreement has been reached with a meaningful number of launching airlines. If these three conditions are met, the Dutch authorities are prepared to make loans available to the Fokker totaling in the order of 1 billion florins, or approximately the equivalent of Fr 2.2 billion, and to grant aid to Fokker identical to that of the F 27 and F 28 programs.

A National Consensus

Replying to our question as to the degree of public support for this policy following the recent elections in the Low Countries, Mr Van Aardenne said that this policy enjoys a consensus that includes Dutch leadership , Parliament and public opinion in general. Mr Van Aardenne, a minister of a government that will very soon be out of office, anticipates that the policy line pursued to date will not be put into question again. It appears that the new Parliament's Committee on Economic Affairs plans to state its position in this matter by the end of August or beginning of September, without awaiting, that is, the debate on the budget as a whole, which would not permit more than a superficial examination of the entire issue.

The Dutch authorities are following this matter very closely, both by way of the reports submitted by Fokker on the reactions of potential clients and through the Dutch Aerospace Programs Agency (NIVR), which exercises supervision over the technical quality of the project and which, as the advisory body of the Low Countries on aeronautics policy, is staffed with highly competent experts and is therefore well equipped to make value judgements on the evolution of this program.

At the end of the exploratory phase currently under way, the Dutch authorities will set forth their definitive views, it being understood that meanwhile they will maintain contact in the matter with the other European governments, particularly through their contribution to the A 300/310 programs. Mr Van Aardenne stressed that this contribution is not negligible either from the standpoint of the capital funds involved or from that of the risks being undertaken, and reiterated that it is to be continued with regard to the A 300-600 program.

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CSO: 3102/368

TRANSPORTATION

NEW COMMUTER LINERS CONTINUE TO REAP ORDERS

Paris AIR & COSMOS in French 18 Jul 81 pp 43,45

[Article by R. N.]

[Text] For several weeks now, orders for future commuter liners have been coming in at a rapid rate, indicating that many feeder airlines throughout the world are now making their choices. In fact, most of the aircraft builders are now in a position to announce the definitive characteristics and calculated performance figures for their planes, and many of the recently placed orders or options probably stem from the competitive exhibits shown at the Salon du Bourget.

In the category of future 30- to 50-seaters alone, a total of at least 500 firm orders or purchase options are in hand, without counting all the orders relating to programs already under way (Havilland DHC-6 and -7, Fokker F-27, British Aerospace HS-748-2B, Shorts 330, etc). Of course, the total estimated market of 2,000 to 2,500 planes is still far from having been attained, but a goodly portion of it is probably in the process of being decided.

The 15-20 Seaters

Certification of the Beechcraft C99 (15 seats, two Pratt and Whitney PT6A-36 engines) is now imminent; mass production of the plane has begun and should achieve a rate of 5 planes per month by the end of this year. According to its builder, the number of orders currently in hand will absorb production through July 1982. The Commuter 1900 (19 seats, two P & W PT6A-65 engines) is still scheduled to make its maiden flight next spring.

British Aerospace has firm orders for five, and has just sold options for another four, of its new Jetstream 31 plane (18-19 seats, two Garrett TPE 331-10 engines).

We recall that its certification is scheduled for the second half of 1982, to be followed immediately by the first deliveries.

The new Dornier DO 228-100 (15 seats, two Garrett TPE 331-5 or -10, or two P & W PT6A-135 or -41 engines, per option) and DO 228-200 (19 seats, same choice of engines) are off to a shiny start of their careers. As of mid-June, 67 had been sold, of which 46 are paying options, with first deliveries scheduled for December 1981 and April 1982 respectively.

Swearingen, after having announced the certification of its Metro III (19 seats, two Garrett AiResearch TPE 331-11U-601 G) at the Salon du Bourget, has delivered the first plane of the series to the Swiss Crossair company; the plane is being built at a rate of 6 units per month.

Piper's two planes in its T-1000 program--the T-1020 (9 passengers, 2 Lycoming T10-540 engines), an offspring of the Chieftain, and the T-1040 (9 passengers, two P & W PT6A-11 engines), an offspring of the Chieftain and the Cheyenne 1--although in a smaller category, should not be overlooked. The first of these types could enter service by November, while the second will not be certified until January 1982. Piper has not yet announced any orders for these two types.

The 25-45 Seaters

In the 25- to 45-passenger category, orders and options already in hand among the five leading competitors (ATR 42, CN 235, Dash 8, EMB-120, and SF 340) are approximately equivalent to one another at this time and number close to 110 in all.

The decision to launch the ATR 42 program, which is to be developed jointly by AEROSPATIALE [National Industrial Aerospace Company] and AERITALIA [expansion unknown], will not be taken until October; this, however, has not prevented the two firms from accepting the first option contracts involving financial commitments, and pursuing studies of design details. In addition to the basic model, with a capacity for 42 seats at 32-inch spacing (or 46 seats at 31-inch spacing), several versions are being planned: the "combi" (40 percent cargo, 60 percent passengers); the "quick change," equipped with a cargo hatch and rapidly convertible to accept type LD-3 containers; the "tout cargo [all cargo]" (no windows), the "cargo militaire" with axial loading; and a lengthened version that can accommodate 60 seats and that could be operational 3 years after the initial deliveries of the basic model (last half of 1985).

The other competitors have the advantage of a slight lead, in that their expected dates of entry into service all fall within the year 1984. Their feasibility studies are already under way and, for some of them, the first metallic hatches designed for their prototypes are already being machined. CASA and Nurtanio have announced a military version of the CN235, and Embraer has announced a mixed cargo-passenger version of the EMB-120; but to date, Saab and Fairchild are the only ones who have offered a "business" version of their planes. The latter version seems moreover to be meeting with lively reception, since 25 units of this type have been ordered. Saab and Fairchild are also the only ones to date to have announced the choice of avionics based from the start on the use of color cathodic display (Collins). The most advanced in terms of time lead is unquestionably the Shorts 360, nonpressurized, a prototype that has been under test since 1 June, and the first production unit of which is to be deliveres by the end of next year.

Lastly, in the 50-seater category, the appearance on the market of a new American competitor, the CAC 100, must not be overlooked; its builder, the Commuter Aircraft Corporation, expects to put it into service by the beginning of 1984 (see AIR & COSMOS No. 866 p 21).

Characteristics and Marketing Status of 30- to 5-Seat 'Commuters' [p 1 of 2]

Builder(s)	SNIAS Aeritalia	CASA Nurtanio	Commuter Aircraft	D.H. Canada	D.H. Canada	Embraer
Designation	ATR-42	CN-235	CAC-100	DHC-7	DHC-8	EMB-120
Seats[1]	42	34	50	50	36[11]	30
Service date	Mid-1985	End of 1984	Start of 1984	In service	Mid-1984	End of 1984
Engines	P & W 100/2	G.E. CT7-7	P & W PT6A-45A	P & W PT6A-50	P & W 120	P & W 115
Takeoff weight (kg)	14,510	1,300	-	19,958	13,835	9,072
Cruising speed (km/hr)	511	469	555	428	500	535
Cruising range (km)[4]	1,400	1,450	1,110	1,350	1,200	925
Firm orders / Options	100	54 / 18	-	125	115	110
Price[8]	5	3.8	-	-	4.7[9]	3.5

FOOTNOTES TO CHART

1. At 32-inch (0.813 m) separation.
2. At 29-inch (0,737 m) separation.
3. At 30-inch (0.762 m) separation.
4. With full complement of passengers and IFR reserves.
5. Without reserve.
6. Inclusive of all models.

[continued on facing page]

Characteristics and Marketing Status of 30- to 50-Seat 'Commuters' [p 2 of 2]

Builder(s)	Fokker	Gulf-stream	British Aero-space	Saab Fair-child	Shorts	Shorts
Designation	F-27 MK 200	G-1-C	HS-748-2B	SF-340	S-330/200	S-360
Seats[1]	44	38[2]	48[3]	34[3]	30	36
Service date	In service	In service	In service	Start of 1984	In service	End of 1982
Engines	RR-Dart MK536-7	RR-Dart MK-529	RR-Dart MK-536-2	G.E. CT7-5A	P & W PT6A-45R	P & W PT6A-65R
Takeoff weight (kg)	20,410	16,308	21,092	11,734	10,387	11,657
Cruising speed (kg/hr)	480	490	452	480	352	391
Cruising range (km)[4]	1,925	965	1,556	1,520	770[5]	425
Firm orders Options	725[6]	3 6[10]	345[7]	100	90	21
Price[8]	-	1.6[10]	-	3.75	-	3.25

FOOTNOTES TO CHART - cont'd

7. Series -2A and -2B inclusive.

8. 1981 price in million U.S. dollars.

9. In million Canadian dollars.

10. Modifications of Gulfstream 1.

11. At 31-inch (0.787 m) separation.

An Important Market for the Engine Manufacturers

Although the feeder airline companies are only now making their choices among the available aircraft, the builders themselves have already practically all made their definitive choices of engines, thus opening markets that could amount to many thousands of units for each of the competing engine manufacturers.

The lower range of these markets, that is, for 15- to 20-seater planes requiring turbines of less than 1,000 horsepower, is divided between Pfatt and Whitney, with its PT6 penetration, and Garrett, with its TPE 331 series. Only Dornier offers its clients a choice between the two manufacturers for the DO-228-100 and -200.

The 25- to 45-seater category, with its higher power requirements (up to 2,000 horsepower), has put Pratt and Whitney, with its new PW 100 (ex-PT7) turbine, into competition with General Electric and its CT7. With the recent decision by AERO-SPATIALE and AERITALIA to equip the ATR42 with the PW 100/2 (2,280 thermodynamic horsepower derated to 1,800 shaft horsepower), the balance has been tipped in favor of the Canadian manufacturer, who has thus obtained a share of the market represented by the powering of 3 out of the 5 major planes currently under development. The two arguments invoked in favor of this choice are, on the one hand, the developmental margin of the PW 100 (around 20 percent, enabling the attainment of nominal powers above 2,500 horsepower) and, on the other hand, the special design of the engine based on its use in this type of aircraft (for example, it is equipped with a propeller brake enabling the generation of air and of power for the plane's electrical circuits on the ground). Brasilia's EMB-120 will be equipped with the PW 115 version, derated at 1,500 horsepower, and the Dash 8 with the PW 120 version developing 2,100 horsepower at takeoff.

The principal argument, on the other hand, in favor of the CT7 is that it is derived from the T 700 turbo engine, which has amply proven itself in helicopters. The CASA-Nurtanio 235 will be equipped with the CT7-7, derated at 1,700 horsepower, and the Saab-Fairchild 340 with the CT7-5A, developing 1,675 horsepower.

Also worthy of note is the development by Garrett of its TPE-331 14/10, developing from 1,300 to 1,650 horsepower, which has just begun its bench testing.

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CSO: 3102/371

TRANSPORTATION

VOLVO PRESENTS COMPUTER-CONTROL TURBO ENGINE

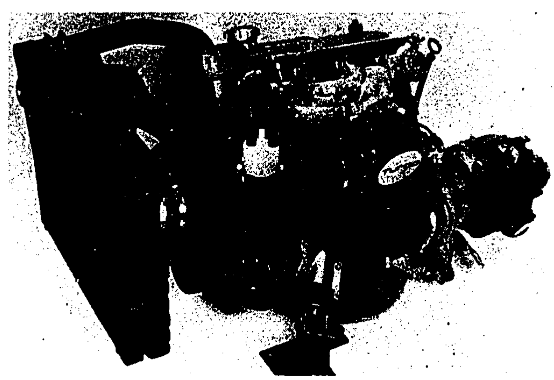
Stuttgart MTZ MOTORTECHNISCHE ZEITSCHRIFT in German Jun 81 p 248

[Text] In the context of the SAE (Society of Automotive Engineers) conference, which was held in February 1981 in Detroit, VOLVO presented a four-cylinder gasoline engine with the most up-to-date technology.

Equally impressive as the almost 25-percent increase in power is the 15-percent lower fuel consumption.

Based on the 155-hp (114-kW) 2.1-liter engine used in the VOLVO 244 Turbo, this VCCT (Volvo Computer Control Turbo) engine delivers 198 hp (146 kW) for short periods. Figure 1 shows an engine with the turbocharger and intercooler.

Fig. 1. The VCCT engine with turbocharger and intercooler from Volvo.



Volvo engineers succeeded in reconciling conflicting specifications through the use of numerous electronic components. Ignition and fuel-injection on the VCCT engine are controlled by microprocessors. Various sensors at different locations on the engine transmit electrical impulses to a tiny computer, which then determines the ignition timing as well as the fuel-air mixture corresponding to engine load.

Thanks to this sensitive electronic control, which reacts instantly to every change in operating conditions, such as engine load, engine speed and temperature, the engine offers rapid throttle response, clean exhaust and high performance with low fuel consumption.

Turbocharger boost pressure is also monitored electronically to provide optimal fuel metering. A knock sensor also informs the microprocessor when there is a tendency to knocking or pinging in the combustion chamber; if necessary, the boost pressure can be reduced and the ignition timing can also be changed. In this way, the engine adapts by itself to the octane level of the fuel being used at the time.

On the other hand, the minicomputer can also raise the boost pressure by almost 50 percent for a period of 10 to 15 seconds. Thus the vehicle has a considerable increase in power available for short periods, for example while overtaking. Normally, at a boost pressure of 0.65 bar, engine output is 155 hp (114 kW) at 5,400 revs/min, with a torque of 26.5 kg/meter (260 Nm) at 3,200 rev/min. The microprocessor helps it to achieve maximum figures of 198 kp (146 kW) and 33.6 kg/meter torque at the same engine speeds and a boost pressure of 0.97 bar.

The resulting performance figures--assuming the engine were installed in a VOLVO 244 series sedan are quite impressive: The car would reach 100 km/hour from rest in less than 8 seconds, in a test of engine flexibility, 90 to 140 km/hour in 4th gear would take only 9.6 seconds, and top speed would be over 200 km/hour. At the same time, fuel consumption would be 10 to 15-percent lower than with a current series VOLVO 244 Turbo.

With the VCCT engine, important progress has been successfully achieved in engine specifications: cleaner exhaust gases, lower consumption, more power and torque as well as less loss of performance when using fuel with a lower octane rating.

During the next few years Volvo will incorporate some of the experience gained with the VCCT system into the construction of its production engine.

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CSO: 3102/377

TRANSPORTATION

VW DEVELOPS STOP-START DEVICE FOR ENGINE TO CUT FUEL USE

Stuttgart ATZ AUTOMOBILTECHNISCHE ZEITSCHRIFT in German Apr 81 pp 153-154

[Article by Erwin Schuster and Ernst-Olav Pagel: "The Stop-Start Device"]

[Text] Abstract

With regard to increasing fuel cost and shortage of energy resources, the automotive industry is bound to develop suitable methods for optimum fuel utilization. Thus, the automobile can be maintained as an attractive and competitive means of transportation.

A novel development which can lead to considerable fuel savings and release the environment at the same time is the stop-start device. This device allows, during vehicle stops, elimination of fuel consumption, i.e., the fuel will only be utilized to keep the vehicle moving and not for heat conversion during idling. This stop-start device is installed by VW and Audi on various models of the "Formula E" concept.

1. Introduction

The stop-start operates semiautomatically: The driver can decide independently whether the traffic situation allows turning off the engine; starting is initiated automatically by simultaneously depressing the accelerator and clutch pedals, while the operating condition of the engine is monitored by a digital-electronic switch mechanism. Development of this device required some basic tests, for example:

--when does it make sense to switch off the engine to save fuel?
--what is the effect of a restart on exhaust emissions?
--what additional loads are imposed on the starter and the battery?
--what influence does it have on the balance of the vehicle's electrical system?

2. Fuel Consumption Measurements

The first test concerned how high the fuel consumption is at idle and the amount of fuel the engine requires when starting. Tests showed that an Audi 80 LS with a 55-kW (75 hp) engine, for example, has a consumption at idle of 0.349 cm^3/sec, and 1.867 cm^3 when starting up. The conclusion is that for this vehicle fuel is saved after remaining stationary for longer than 5 seconds.

3. Exhaust Emissions Levels

Exhaust emissions levels in the EEC-cycle, Figure 1, were determined with and without stop-start operation; it was shown that only minor deviations resulted, Figure 2.

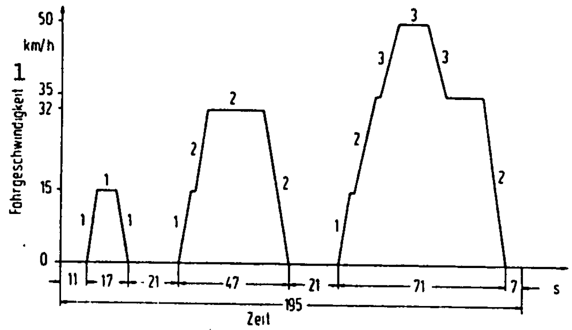

Fig 1--EEC-city cycle; vehicle speed characteristics versus time including gear position designations. The test consists of an advance period of 40 secs. at idle (no measurement). The measurement is conducted by repeating the driving cycle four times while an idle share of four times 60 secs. is resulting, which represent about 30.8 percent.

Key:

1. Speed

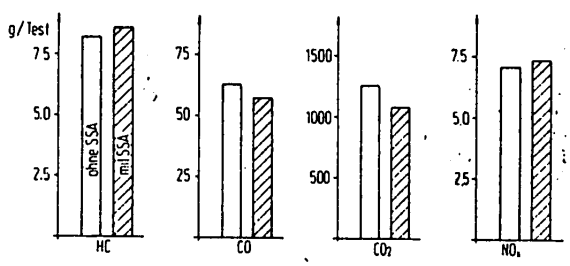

Fig 2--Emission data from the EEC-city cycle (European test) with and without stop-start device (Audi 100 S). ☐ without ▨ with stop-start device

By switching off the engine through the idle cutoff valve in the carburetor, emission of unburned HC remains is prevented while the engine is coming to a stop. Against this, there is a slight rise in the HC level because of the starting process, so that an increase of 4.8 percent in the EEC cycle is registered. On the other hand, CO levels declined, as expected, by about 10 percent in stop-start operation, while the NO_x level increases slightly, with 2.3 percent.

Further tests were conducted to determine what influence a stop-start device has under actual traffic conditions on a vehicle's electrical system balance.

4. Test Drive

For this a route was worked out in Munich, over which several vehicles were driven at different times of the day. Instrument readings were taken of battery charge condition, engine revolutions, the vehicle's electrical consumption, number of engine stops, etc. The average figures from several trips showed:

--Route driven	91 kms
--Number of engine stops	112
--Total driving time	200 mins
--Time vehicle stationary	41 mins

The results show:

--Stops per kilometer	1.24
--Time stationary per stop	22.1 secs

If the numbers calculated above are used as a basis for calculating fuel consumption, the result is an average fuel saving of about 5 percent for an Audi 80 LS with a 55-kW (75 hp) engine, while on some trips under particularly unfavorable conditions savings of up to 10 percent are possible.

5. Starter Load

The calculated numbers also yield some information about the altered load on the starter and the battery. The starter is naturally subject to an extra load during stop-start operation, but this additional load does not materially affect its life, due to a peculiarity of the electronic switch unit.

The control switch monitors engine revolutions during starting; when they reach 500 revs/min, as the engine is run up, the starter is automatically switched off. This protects the roller clutch in the starter from overloading (in contrast to starting with the ignition switch). This component is therefore not subjected to any additional load from stop-start operation.

Through a link with engine temperature, there is also a safeguard that the device is activated only when the engine has reached operating temperature. A start with a warm engine normally lasts about 0.5 sec; carbon brushes, main bearings, etc, experience hardly any extra load compared with normal operation.

6. Battery Charge Condition

The state of charge of the battery is not influenced by starting operations. However, discharge of the battery during stopped time has a negative effect due to other sources of consumption, such as the heater fan, lights, radio etc. A balance is created by automatically switching off the rear window defogger. There is additional relief for the system in that the energy output of the generator at idle is minimal; consequently the amount of energy that is lost (or is not generated) by stopping the engine is negligible and has hardly any effect on the total balance of electrical generation, or consumption. Another positive factor is that the vehicles have a generous capacity generator as standard equipment.

The result of the measures described is that there is no deterioration in the battery's state of charge during stop-start operation.

7. Description of Operation

The vehicle must be started the first time in the normal way, so that the device is activated. When engine revolutions exceed 30 revs/min, the device switches to ready for operation, with a delay of 2 seconds; this is an additional precaution against unintentional operation of the starter. After the first start with the ignition key the stop-start device can be used as often as is desired, until it is locked out again by turning off the ignition (ignition key). To avoid starting problems with a cold engine, the stop-start device is also locked out as long as the cold warning light is on, Figure 3.

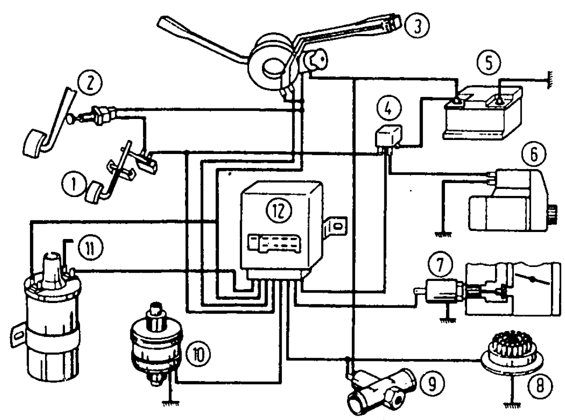

Fig 3--Operational schematic of the stop-start device

Key:

1. Accelerator pedal switch
2. Clutch pedal switch
3. Stop button
4. Starter relay
5. Battery
6. Starter
7. Magnetic idle valve
8. Carburetor preheater
9. Coolant temperature switch
10. Vehicle speed sender
11. Revolutions from the coil
12. Stop-start control unit

To turn off the engine with the device, a button on the end of the wiper lever is pushed. Vehicle speed below 5 km/hour is a condition for activation. An electronic control unit interrupts the electrical circuit to the idle cutoff valve. The engine comes to a stop.

To reduce electrical consumption the rear window defogger is switched off while the vehicle is stationary.

To start the engine again, the clutch and accelerator pedals must be operated simultaneously. The starter is switched on by the electronic control unit through servorelay, until the engine has reached a crankshaft speed of 500 revs/min; at this speed the control unit automatically switches off the starter.

If engine revolutions drop below 500 revs/min after this, the starter does not cut in by itself, even though the accelerator and clutch pedals are depressed. Only after revolutions have dropped below 30 revs/min and the pedals are operated again is the starter activated. This prevents uncontrolled switching on and off of the starter at irregular engine revolutions around 500 revs/min.

As a result of the double actuation of the pedals when switching off and starting, and by wiring the control connections to the positive side of the battery (terminal 15), a safeguard is provided against individual malfunctions (detached connections, sticking switches, etc) causing a dangerous condition, in which the stop-start device goes out of control and starts the engine.

8. Summary

The automatic stop-start device makes up to a 10 percent saving in fuel possible under unfavorable conditions and when it is used consistently. It also contributes to reducing environmental pollution by lowering emissions of poisonous carbon monoxide.

Safe operation of the device in traffic is guaranteed by comprehensive electronic protective measures. The balance of the vehicle's electrical system is affected only slightly.

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CSO: 3102/355

END