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REQUIREMENTS FOR BATTERIES INTO THE 80's

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1. INTRODUCTION

The battery business is presently one of the most challenging among automotive components. After half a century of rather conservative empirism, it is now giving matter for extensive basic and applied research programs.

Besides the application as Starting-Lighting-Ignition (SLI) energy source in the automotive field and the aiready diffused use as traction power source in certain cases as fork-lift-trucks, a fundamental interest has been assigned to the batteries for the emergent field of electric vehicles.

As responsible of the Fiat Research Center I would report the point of view of a car manufacturer on some items of interest in your and our activities.

We will start our considerations from the application to I.C.E. vehicles, going later on to the traction applications to pure electric or hybrid vehicles.

2. SLI BATTERIES

Total SLI battery production in Western Europe is over 40 million units with a forecast for 1980 of 14 miliion for the original equipment. Battery is therefore an important item in the original equipment market.

Each car manufactu rer would like to obtain an important contribution on its goal of cost, weight, size reduction and reduced maintenance need from components manufacturers. One of the ways to get it is the battery, the heavy, bulky and (tilt few years ago) dirty, black box.

function is utilized as a buffer, which makes independent the utilization of electric power from its generation.

Typically the generation occurs through the electric generator in a low-power continuous feeding, while the utilization occurs in form of a high power - short time discharge during starting, and additionaly in form of a low-power discharge in those conditions in which the generator power is not sufficient to supply the amount of power required by the on-board utilizers.

The first requirement to be met by the battery is: sufficient power to assu re the starting ability. In particular, the "voltage/current" characteristics has to be established in relationship with the characteristics of the engine (spark ignition, diesel engine) and puts a limit in terms of battery siting.

Another requirement regards the battery capacity. The capacity has to be determined in relationship with the electrical balance between generation - utilization considering also emergency conditions, such as prolonged or repeated cran king conditions or power supply to utilizers with generator out of operation or when it generates less power than used (in special conditions such as city stop and go with all the electrical loads on). Furthermore a battery of too small capacity can result in a shorter life due to frequent possibility of deep discharges. A suitable reserve capacity, therefore, shall be kept in mind as a security factor.

Using lead-acid batteries the requirement on power level usually (unless for special environmental conditions or type of engine) overcome the capacity requirement because the inherent characteristic of the battery assures a corresponding overwhelming capaci ty . New battery system, such as alcaline battery, provides instead higher power for a given capacity.

4. SUMMARY REMARKS

As conclusions, the recommendation to battery manufacturers related to SLI batteries is to keep in mind the following points :

. weight and size of the battery should be reduced in order to allow better performance of the vehicle (fuel economy and. acceleration), without cost penalties;
. the battery shail withstand occasiona1 deep discharges without loosing performance and shall be fully recharged under normal regulator voltage setting;
. the endurance specs shall discourage any battery design inducing detriment to life;
. reliability of the product shall be improved.

For traction batteries the requirements arise from a technical-economica1 trade-off depending on the application, or type of vehicle and type of mission :

- for pure electric vehicles the specific energy is very important, since it is tied to the range;
- however, the cost per unit of energy cumulatively obtained by the battery, or its cost related to life cycle appears to have the priority for cost effectiveness;
- for hybrid and dual mode vehicles different parameters than in the case of pure electric vehicle have to be considered, such as specific power as well as charging-discharging efficiency;
- the battery response on vehicle is influenced by the electrical - thermal - mechanical envi ronmental conditions, so that a characterization of batteries under this aspect as well as interfaces with vehicle and electrical network is fundamental.

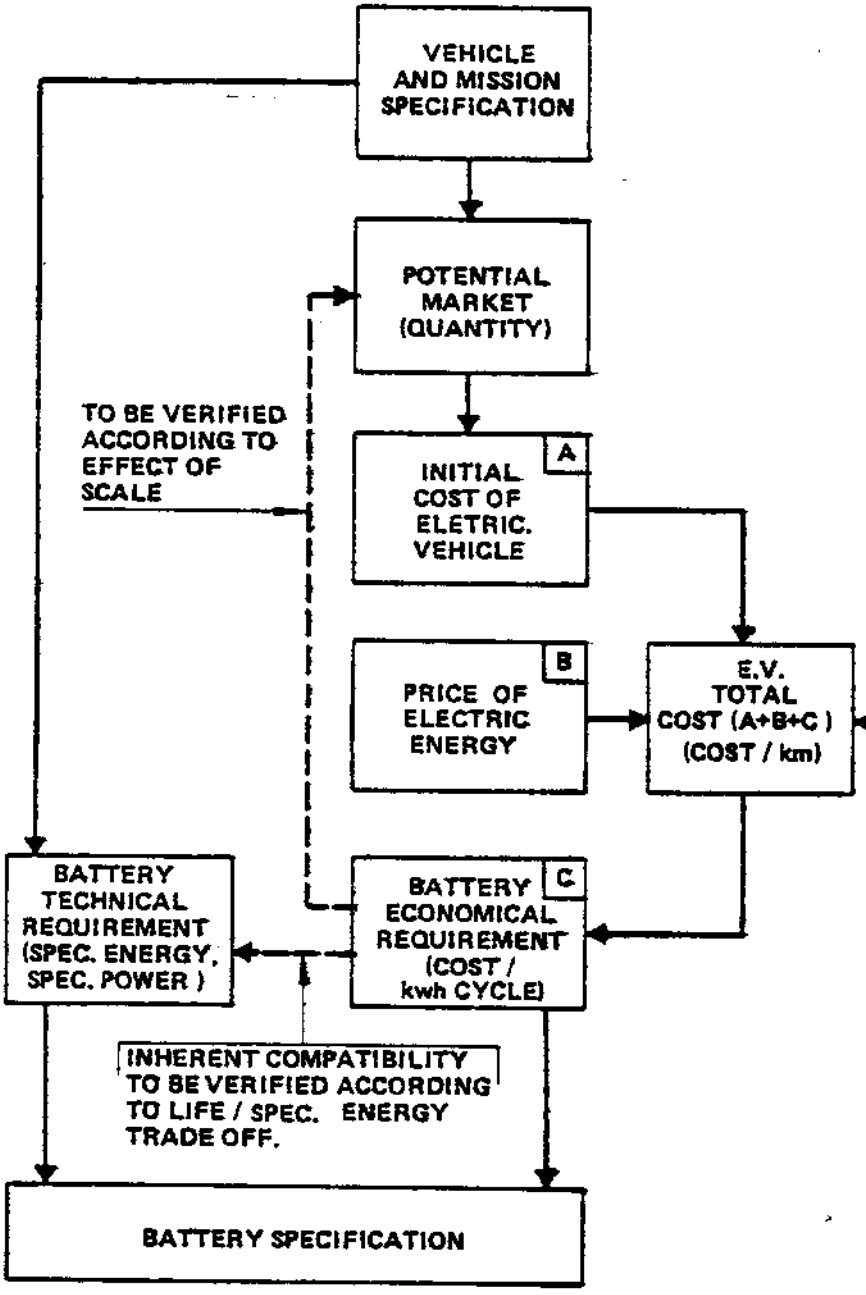
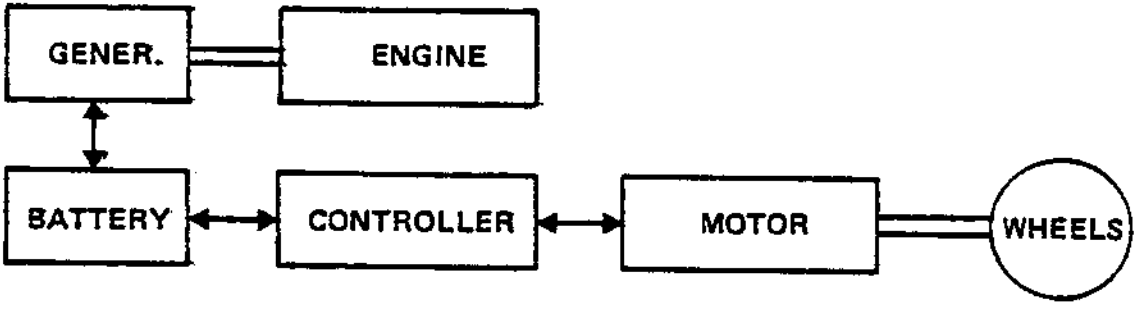

VEHICLE AND MISSION SPECIFICATION
POTENTIAL MARKET (QUANTITY)
TO BE VERIFIED ACCORDING TO EFFECT OF SCALE
INITIAL COST OF ELETRIC. VEHICLE
A
PRICE OF ELECTRIC ENERGY
B
E.V. TOTAL COST (A+B+C) (COST / km)
BATTERY TECHNICAL REQUIREMENT (SPEC. ENERGY, SPEC. POWER)
BATTERY ECONOMICAL REQUIREMENT (COST / kwh CYCLE)
C
INHERENT COMPATIBILITY TO BE VERIFIED ACCORDING TO LIFE / SPEC. ENERGY TRADE OFF.
BATTERY SPECIFICATION

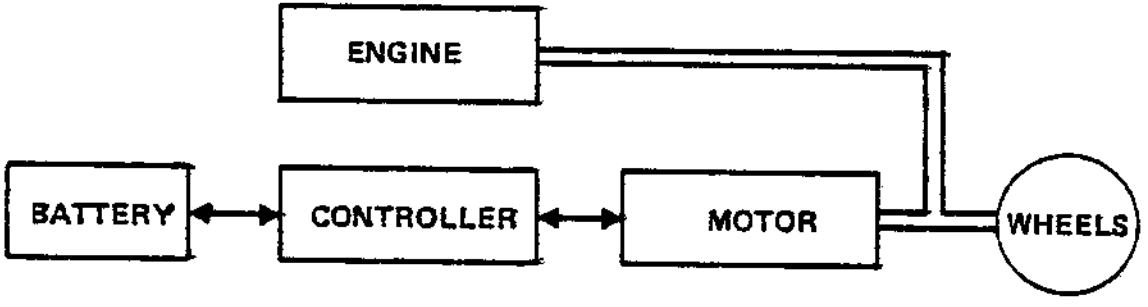
Fig. 5

BATTERIES FOR HYBRID AND DUAL MODE VEHICLE

HYBRID (SERIES CONFIGURATION)



HYBRID (PARALLEL CONFIGURATION)



ELECTRICAL DUAL MODE

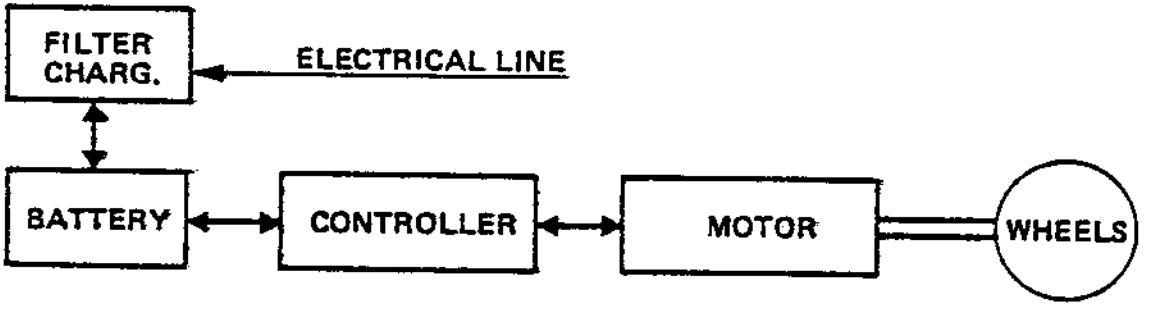


Fig. 9