

AEROMOBILE, ARCOPTER, AEROPLOW, AIRTRACK, AND OTHER USES OF GROUND EFFECT

by

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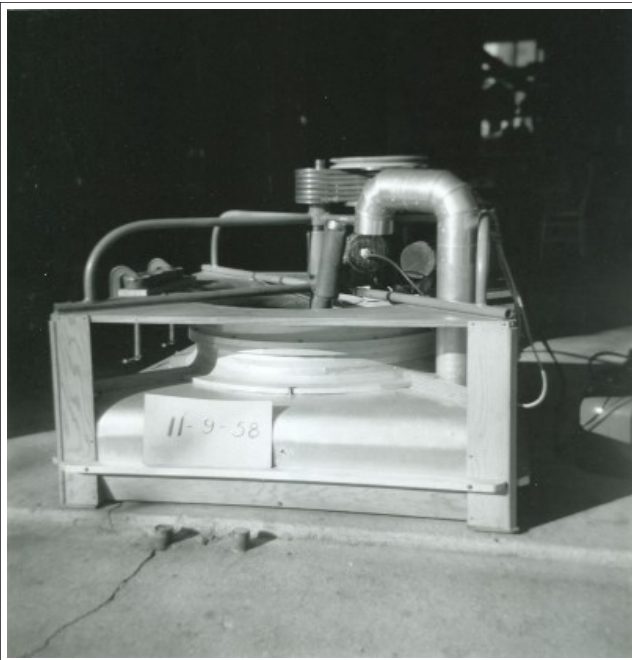


Fig 1.

The development of the ground effect machine by this company has proceeded both vertically and horizontally in the two years since I last reported to this Society. It has expanded vertically in the form of new machines with greater power, speed, and performance and also horizontally into new areas of application.

Since the Aeromobile 72 was shown to the A.S.A.E, in December 1957, we have built four more ground effect machines, two of pure peripheral jet type Aeromobiles and two of them wing type called Arcopters.

The total now is seven full scale ground effect machines starting with a 4 foot square 35 H.P. peripheral jet machine. (fig. 1) The second was a 35 H.P. 6 x 8 foot peripheral jet machine (fig. 2). This was converted to 72 H.P. (fig. 3).

The Aeromobile 200-1 with 200 H.P. was the fourth machine (fig. 4). Aeromobile 200-2 built for the U. S. Department of Commerce, Office of International Trade Fairs, was identical in chassis to the 200-1 but had a highly styled body (fig. 5). This machine is being exhibited by the USA at International Trade Fairs all over the world. It has been shown at Tokyo, Japan; Turin, Italy; Zagreb, Yugoslavia; and is now in New Delhi, India. It has been the principal attraction at every Fair, drawing as many as 188,000 people daily to the U. S. Pavilion.



Fig 2.

The ram wing type of ground effect vehicle is our oldest effort in ground effect and was derived from an experimental vertical take off aircraft, the Arcopter (fig. 6). This led to the Arcopter GEM-1 (fig. 7) and the Arcopter GEM-2 (fig. 8).

The object of experimentation on a broad front with several types of ground effect vehicles is to evolve a useful, practical commercially feasible vehicle for personal use in all weather over all kinds of terrain. This is a very ambitious undertaking as there never has been such a vehicle. But we are approaching the point of great utility with an exceptional performance vehicle for certain special tasks. Having a complete new and untried medium to explore, it was only through actual field testing of full scale vehicles that we were able to discover the problems existing in ground effect travel and then attempt to solve them. This was the process with the automobile, the airplane, the helicopter, the reaper, cornpicker, cotton picker, and all other devices.



Fig 3.

Every machine we have ever built was too heavy, too inefficient, too underpowered, etc. in addition to the idiosyncrasies of the individual machine. After extensively testing the seven machines we have the "feel" of ground effect problems and access to their solutions.

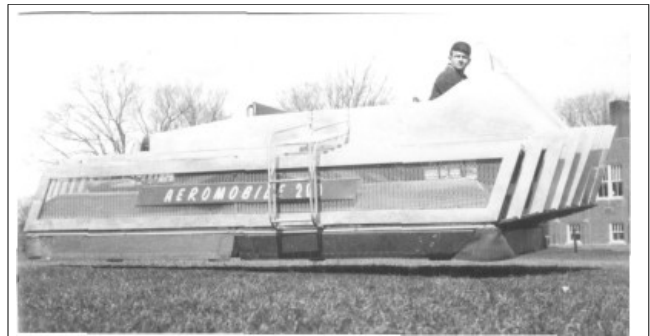


Fig 4.

The following list is a composite of problems arising in various machines:

1. Dust, spray, mud mobilization and throwing in hover and consequent fan erosion.
2. A minimum ground clearance, over 10% h/d (height to base diameter or width) is required with reasonable useful load to make rough ground negotiation possible.
3. The very real but not insurmountable stability "barrier" arises at over 10% h/d.
4. A horse power "barrier" arises over 10% h/d where exponential increase in power seems necessary.
5. A minimum propulsive force is needed to negotiate grades and high winds or both and a minimum braking force to stop quickly at high speed over rough ground or on ice, snow.
6. A minimum radial force is needed to produce tight turns at high speed with a frictionless machine.

7. A pitching moment at high speed tends to raise the nose, the pitch-up phenomenon.



Fig 5.

The peripheral jet machines are superior in certain respects and the ram wing machines are superior in others. Each has its limitations which we could only discover by thorough testing of both types by the time consuming and expensive "hardware" method. This is a field like farm machinery in which theory and calculation have a limit beyond which only trial and error will supply answers.

We will very soon offer a production water vehicle at a price competitive with inboard motor boats and with the same horse power and fuel consumption, but with speeds double or triple boat speeds. The fact that this vehicle will also travel over frozen or dry lakes or rivers and will come ashore is a very valuable fringe benefit. Fitted with wheels it can be roadable as an automobile. It will have flotation to "park" on water.

The immediate uses for the G.E.M. (Ground Effect Machine) will be as a means of fast commuting over large lakes and rivers and flat land, winter and summer, for people going to work, sportsmen, explorers, field service personnel, physicians, veterinarians, wild life wardens, etc.

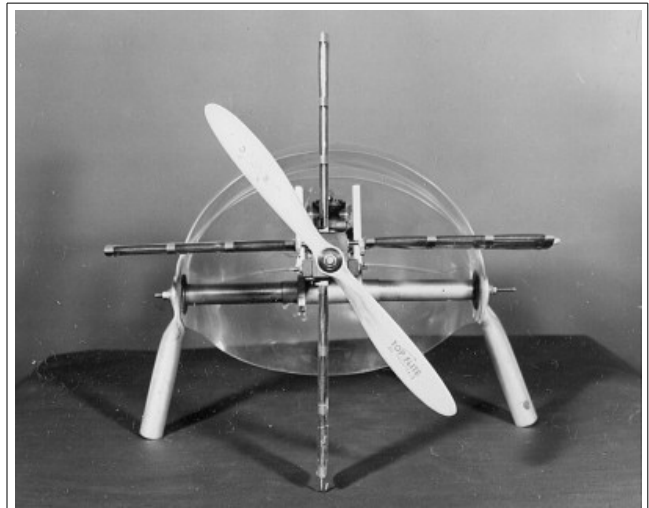


Fig 6.

Our horizontal diversification in ground effect occurs in the form of the Aeroplow (fig. 9), the Airtrack (fig. 10) and other devices. These are of interest to agricultural engineers.

The Aeroplow has been further developed in the last two years , and considerable qualitative information has been gathered by experimentation. The principle of operation is similar to the Aeromobile in which air lubricates the passage of the machine over the ground. In the plow, air lubricates the passage of the ground over the machine. An air compressor run by the tractor power take off pumps air to the plenum box behind the mold board. Perforations in the share and

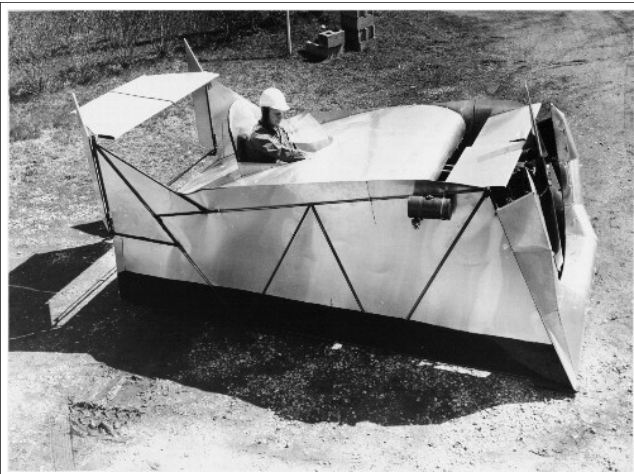


Fig 7.

the mold board allow direct pressurization under the furrow slice to keep it off the plow itself after it leaves the point of the share. The friction of plowing is therefore almost eliminated. There remains only the draft force of cutting and lifting the dirt. Friction is a very significant waster of power in plowing and is much worse in sticky soil. It is safe to say now that the power required to pump the air will be only a fraction of that now wasted in heat of friction.

The Aeroplough makes it possible to scour under all conditions. The lower draft force will allow more bottoms to be pulled by the same tractor or the same number of bottoms by a smaller tractor. Plowing can continue under wetter soil conditions since less traction is needed. The plow can be designed for higher speeds with lower pitch since elongation of the moldboard no longer causes prohibitive scouring problems and draft force increase.

The Aeroplough development will continue and will ultimately become producible.

The Airtrack is yet another off shoot on air lubrication. It is a track laying vehicle without bogies. An air lubricating sliding shoe can substitute for all the wheels in the crawler unit except the drive sprocket. A rubber endless track or track base with or without cable cords or metal cleats fits tightly around the air chamber with perforations at the track interface. Air pressure in the chamber maintained by a compressor pressurizes the space between the rubber track and the guide preventing contact and friction. The result is a very light weight, inexpensive, amphibious crawler



Fig 8.

tractor unit with little maintenance. It can be air dropped and floats on landing. It propels itself on water, quicksand, mud, snow or dry ground. The Airtrack will be higher speed than the conventional crawler unit.

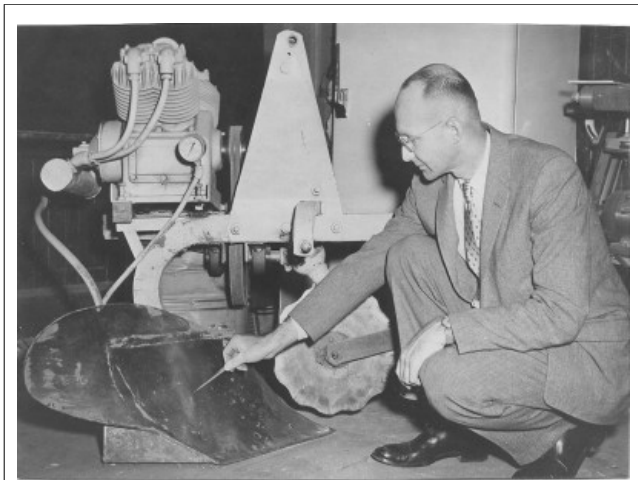


Fig 9.

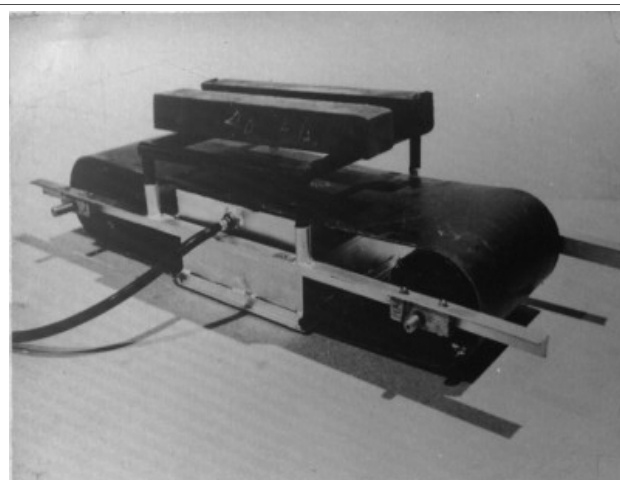


Fig 10.

There will be less competition between the conventional heavy duty crawler tractor and the Airtrack than between the latter and rubber tired tractors and utility vehicles, The Airtrack concept makes possible the extension of track laying in much lighter and cheaper equipment and is not recommended for rugged earthmoving equipment where steel is time proven.

The applications for ground effect continue to increase and proliferate. One day we may ponder whether the wheel was not a retarding device to progress as well as the beginning of the machine age.

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