

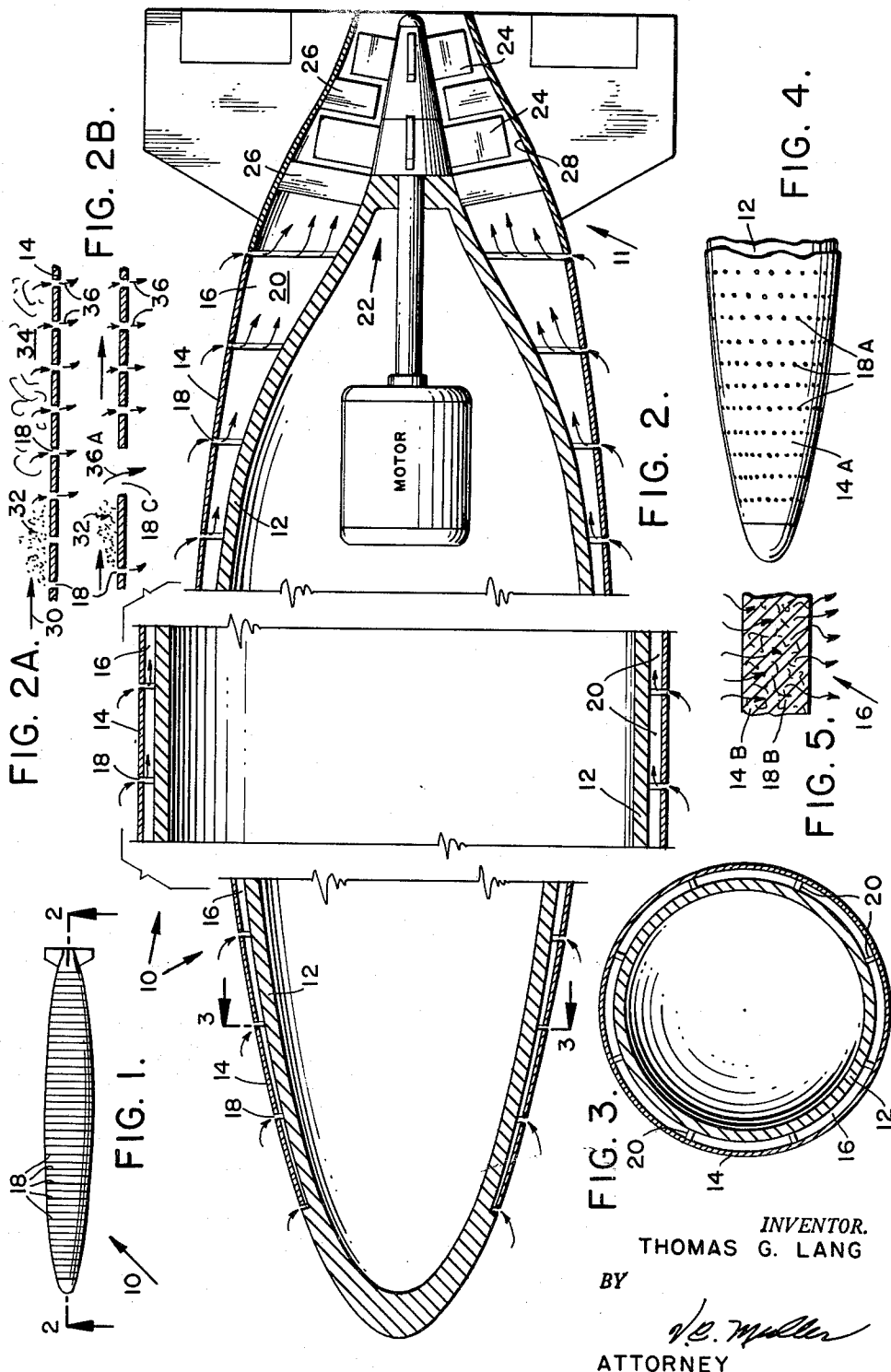
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UNDERWATER MISSILE

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UNDERWATER MISSILE

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2 Claims. (Cl. 114-20)

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The invention described herein may be manufactured and used by or for the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to underwater vehicles, such as torpedoes, and more particularly to improvements in method and apparatus for propelling same.

The ultimate in torpedo design is conceivably a vehicle which is substantially all payload explosive with a propulsion and guidance system of substantially no weight or volume which would carry the payload at any desired speed to any desired range. The obvious impracticability of such vehicle has dictated a judicious compromise between its competing components and the art has been so highly developed that designers of various components are almost invariably restricted to remain within their spacial and weight allotments without encroachment upon those of the others. The problem is further complicated in that certain components may be considered as fixed and others as variable. Thus, if it is desired to deliver a predetermined weight of explosive to a target, the explosive, guidance system, parts of the shell, certain structure and portions of the propulsive elements represent volume and weight which is unaffected by range or speed. Variable components are those the volume of which is proportional to propulsive power such as the energy source, the major portion of the power plant and certain other parts of the shell and structure. For a long range high speed torpedo size reduction becomes cumulative. Thus, if the drag could be decreased by a factor of 2 the displacement of engine and fuel could be reduced about 50%. This reduction, however, would in some cases effect a reduction of about 40% in the wetted surface area permitting a further reduction in the power plant by another factor of nearly 1.5. The resulting reduction in horsepower would thus be a factor of the order of 3 which, as will be apparent, would radically modify present torpedo design. For example, electric propulsion could probably be employed for higher speeds and greater range than heretofore possible.

Analysis has revealed that at high speed with fully turbulent flow, changes in torpedo hull or fin shape cannot effect significant reduction in drag. Since substantially all of the torpedo power is utilized in overcoming drag and since efficiency and performance of power plants has reached a near optimum state of development within allotted space it becomes apparent that if further significant improvements are to be made, radical and unconventional approaches will be required to materially reduce the drag of otherwise hydrodynamically well designed torpedoes.

The principal object of this invention is to provide a novel torpedo which significantly reduces drag as compared with torpedoes heretofore proposed.

Another object is to provide a novel torpedo hull which controls or modifies the water boundary layer and affects material reduction in drag.

A further object is to provide a novel method of boundary layer control.

Still further objects, advantages and salient features will become more apparent from a consideration of the

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description to follow, the appended claims and the accompanying drawing, in which:

FIG. 1 is a side elevation of a torpedo embodying the subject of the invention;

FIG. 2 is an enlarged section taken on line 2-2, FIG. 1, intermediate portions being omitted;

FIG. 2A is a hull section illustrating an undesired flow condition, FIG. 2B is a like hull section illustrating correction of the undesired flow condition;

FIG. 3 is a section taken on line 3-3, FIG. 2;

FIG. 4 is a partial side elevation, similar to FIG. 1; of an alternative form of the invention; and

FIG. 5 is a cross section of an outer hull which may be employed in any of the previous figures.

Referring to the drawing, the subject of the invention comprises a torpedo hull 10 of any desired configuration, exemplary of which, as shown in FIG. 1, is a substantially elliptical hull, the major axis of which is approximately eight times the minor axis with the tail portion 11 modified to approximate a cone. As best shown in FIGS. 2 and 3 the hull comprises an inner imperforate portion 12 of any conventional design which may withstand the pressure at a desired depth of submergence and an outer portion 14 spaced from pressure hull 12 through which water may penetrate into annular space 16 disposed between the two portions. As illustrated in FIGS. 1 to 3 outer hull portion 14 is provided with axially spaced circular slots 18, the portions between slots being supported by the pressure hull by spaced webs 20.

The construction shown in FIG. 4 is essentially the same as that of FIGS. 1 to 3 except that a plurality of spaced apertures 18A are provided in outer hull 14A in lieu of the slots which thus permit the outer hull to be formed from a single sheet of perforate material rather than a plurality of axially spaced annular portions.

FIG. 5 illustrates another form of outer hull 14B in which a porous material is employed for the outer hull through which water may penetrate. An exemplary material is fiber glass batting, the lintors or fibers of which are coated with an extremely thin coating of thermoplastic resin, and then compressed under heat and pressure to bond the fibers where they cross each other into a sheet of strong material but sufficiently porous to permit water to migrate through pores 18B between the fibers or lintors. In view of the ease of molding such material to desired configurations it is particularly advantageous for economical mass production.

The water penetrable material which may be either foraminous with discrete spaced apertures or porous with no discrete apertures permits water from the boundary layer to enter into space 16 when a suction or pressure lower than ambient pressure is established within such space. To provide such suction a pump 22 is employed, exemplary of which is an axial flow pump of the propeller type comprising one or more propeller blades 24 and angularly spaced stators 26 which provide more efficient conditions for water entry into the propeller blades, such pumps being well known in the art. In addition to effecting flow of boundary water from the ambient layer into space 16, the propeller blades serve a second function of directing the water axially rearwardly in a jet, the reaction of which provides the thrust for the torpedo. Preferably, the water is accelerated through a restricting nozzle 28 to increase its dynamic head which, in general, provides increased thrust efficiency.

The pressure drop across the outer hull should be sufficient to prevent outward flow of water at all speeds and angles of attack. If the internal pressure is to be constant at all points then the hull should preferably be so designed to have uniform pressure distribution on its outer surface. If uniform pressure distribution cannot be effected by a particular desired design then the in-

ternal pressure may be variable, by employing manifold-
ing or compartmenting (not shown), to produce uni-
form pressure drop across the various portions of the
hull with variable pressure distribution on the outer sur-
face of the hull. A pressure drop of 4 to 8 p.s.i. will,
in general, be found adequate.

Some clogging of the penetrable material may be ex-
pected since sea water will normally contain particles
which will not pass through the material. While it might
appear that such clogging would reduce the rate of flow
of water through the penetrable shell and thus adversely
affect the performance characteristics of the torpedo such
action will not occur since the tendency to increase suc-
tion head of the pump due to clogging distributes a greater
portion of the applied pump power to creating increased
suction head, thereby maintaining flow rate constant.
While this decreases the distribution of the power applied
to the discharged water, the decrease in propulsion per-
formance is slight since a very substantial portion of the
power is utilized for propulsion and only the minor re-
mainder employed for suction.

Suction of water through a permeable hull tends to con-
trol the boundary layer to maintain its flow laminar; how-
ever, disturbances, such as caused by surface roughness
or hull shape may offset such tendency. Thus in FIG.
2A, there may be laminar flow 30 adjacent hull 14 along a
portion of its length after which surface roughness may
change it to a disturbed laminar flow as indicated by 32.
Continued flow along the hull may cause further distur-
bance until it changes to turbulent flow 34. When this
occurs, uniform suction through the hull adjacent the
turbulent zone will not change the turbulent flow back
to laminar flow. It has been found, however, that the
disturbance in the laminar flow may be nullified if a high
rate of inward flow is effected at a localized zone and be-
fore turbulence occurs. Thus in FIG. 2B, one of the aper-
tures 18 adjacent the beginning of disturbed laminar flow
32 is considerably enlarged in area, as indicated at 18C,
so that the rate of flow 36A is considerably increased
over the flow 36 through the smaller apertures 18. This
nullifies the disturbance and the water again flows laminar
until a further disturbance occurs further rearwardly of
the hull. As will be apparent, a plurality of apertures
18C may be disposed in axially spaced relation along the
hull.

Obviously many modifications and variations of the
present invention are possible in the light of the above
teachings. It is therefore to be understood that within
the scope of the appended claims the invention may be
practiced otherwise than as specifically described.

What is claimed is:

1. A torpedo comprising;
- (a) an elongated hull,

- (b) the major portion of the length of said hull being
of water penetrable material adapted to permit flow
of water from the boundary layer through said hull
into a space therewithin,
- (c) a pump adapted to discharge a jet of water rear-
wardly from the torpedo, said jet providing the sole
source of thrust for propelling same,
- (d) said pump communicating with said space for pro-
viding suction to produce said flow,
- (e) a major portion of the power applied to the pump
being utilized for propulsion of the torpedo and a
minor portion for producing said suction,
- (f) whereby as said material tends to clog with foreign
matter, said pump tends to maintain said flow sub-
stantially constant without substantial decrease in
the propulsion effect of said jet.
2. A torpedo comprising;
 - (a) an elongated hull having circumferential sets of
apertures disposed in axially spaced relation along a
substantial portion of its length and extending there-
through and communicating with a space therewithin,
 - (b) certain of said sets of apertures being of greater
cross-sectional area than other of said sets, whereby
the rate of flow of water therethrough is greater than
through the other of said sets,
 - (c) the sets of apertures having the greater cross sec-
tional area being disposed at positions along the
length of the torpedo at which the laminar flow tends
to change to disturbed laminar flow, to thereby pre-
vent turbulent flow and effect continued laminar flow
across rearwardly disposed apertures,
 - (d) means for maintaining a substantially uniform
suction pressure within said space to thereby produce
greater flow through the sets of apertures of greater
cross section than through the other sets of apertures,
and
 - (e) means for discharging the water entering said space
through the rear end of the torpedo.

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