PROGRESS REPORT FOR DOE GRANT DE-FG02-92ER61426
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Moored instrument for time series studies of primary production and other microbial rate processes.

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OVERVIEW:

The goal of this project is to build and test a Time Series Submersible Incubation Device (TS-SID) capable of the autonomous in situ measurement of phytoplankton production and other rate processes for a period of up at least three months. The instrument is conceptually based on a recently constructed Submersible Incubation Device (SID, Taylor and Doherty. 1990. Deep Sea Res. 37: 343-358). The TS-SID is to possess the ability to periodically incubate samples in the presence of an appropriate tracer, and to store 94 chemically fixed subsamples for later analysis. The TS-SID has been designed to accurately simulate the natural environment, and to avoid trace metal contamination and physical damage to cells. Devices for biofouling control of internal and external surfaces are to be incorporated into the instrument. After the time series capabilities of the instrument have been successfully evaluated by medium-term coastal time series studies (up to one month), longer-term coastal time series studies (2-3 months) will be conducted to evaluate the biofouling prevention measures that have been used with the instrument.

PROGRESS:

According to the proposed time line, construction of the instrument is to be completed by the end of the first year of the grant (31 April 1993) and time series testing of the completed instrument is to begin shortly thereafter. Construction of the TS-SID is precisely on schedule. A diagrammatic representation of the TS-SID as it is presently being constructed is shown in Figure 1. At present (mid-January 1993), all of the electromechanical modules have been built and are undergoing laboratory testing. This includes the a) incubation chamber with biofouling control, b) gear pump, c) subsample distribution valves (2), d) acid injector and e) tracer injector. The electronics package is presently under construction and scheduled for completion by the beginning of February. Software required for this instrument is relatively straight forward and has by-and-large been developed. Routines for all of the electromechanical and data acquisition functions are operational as well as a majority of the routines for integrating the various module functions during a typical time series deployment. As testing proceeds software streamlining and modification will undoubtedly be required.

The TS-SID under construction will incorporate some conceptual improvements over that presented in the proposal. The most significant is the implementation of two 50-port subsample distribution valves (Figure 1A) rather than three 32-port valves proposed in the original conceptual design. Not only does this reduce the number of electromechanical devices required for procurement of subsamples but also eliminates the need for a multiplexor board for the electronic control of the valve modules. Protection from both internal and external biofouling will be effected using the acid injector and a biofouling control collar (see Figure 1D). The biofouling control collar is mechanically connected to

the floating piston so that during normal instrument operation (Figures 1B, C) the exterior of the incubation chamber is subjected to the wiping action of the collar seals as well as exposure to a relatively concentrated solution of HCl.

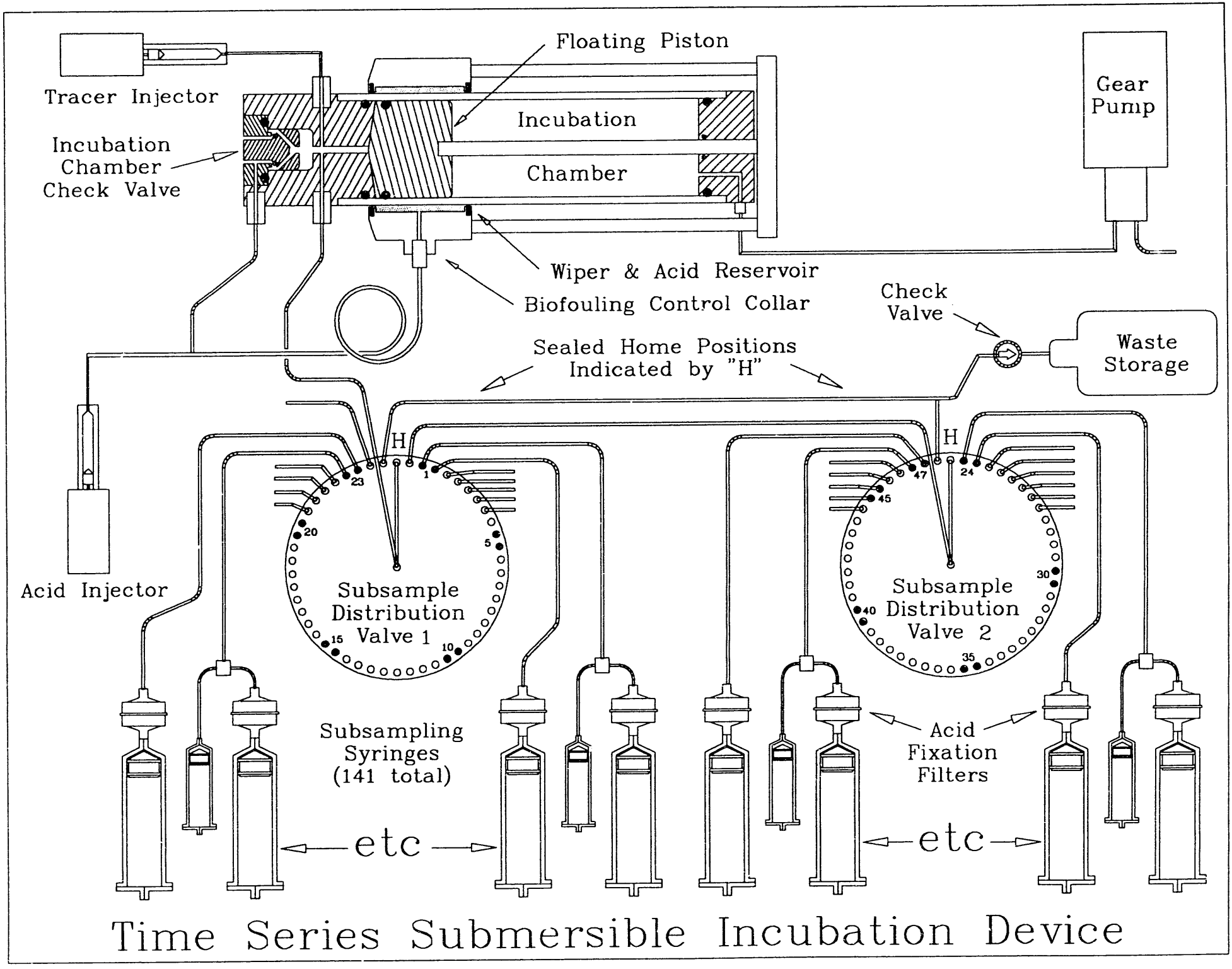
Work remaining between the present and the end of April 1993 is the assembly of the electromechanical and electronic modules into a mooring strength titanium frame. The unit will be configured as illustrated in Figure 2.

The testing program in year 2 will be executed as indicated in the proposal.

Figure 1. Schematic of the TS-SID.

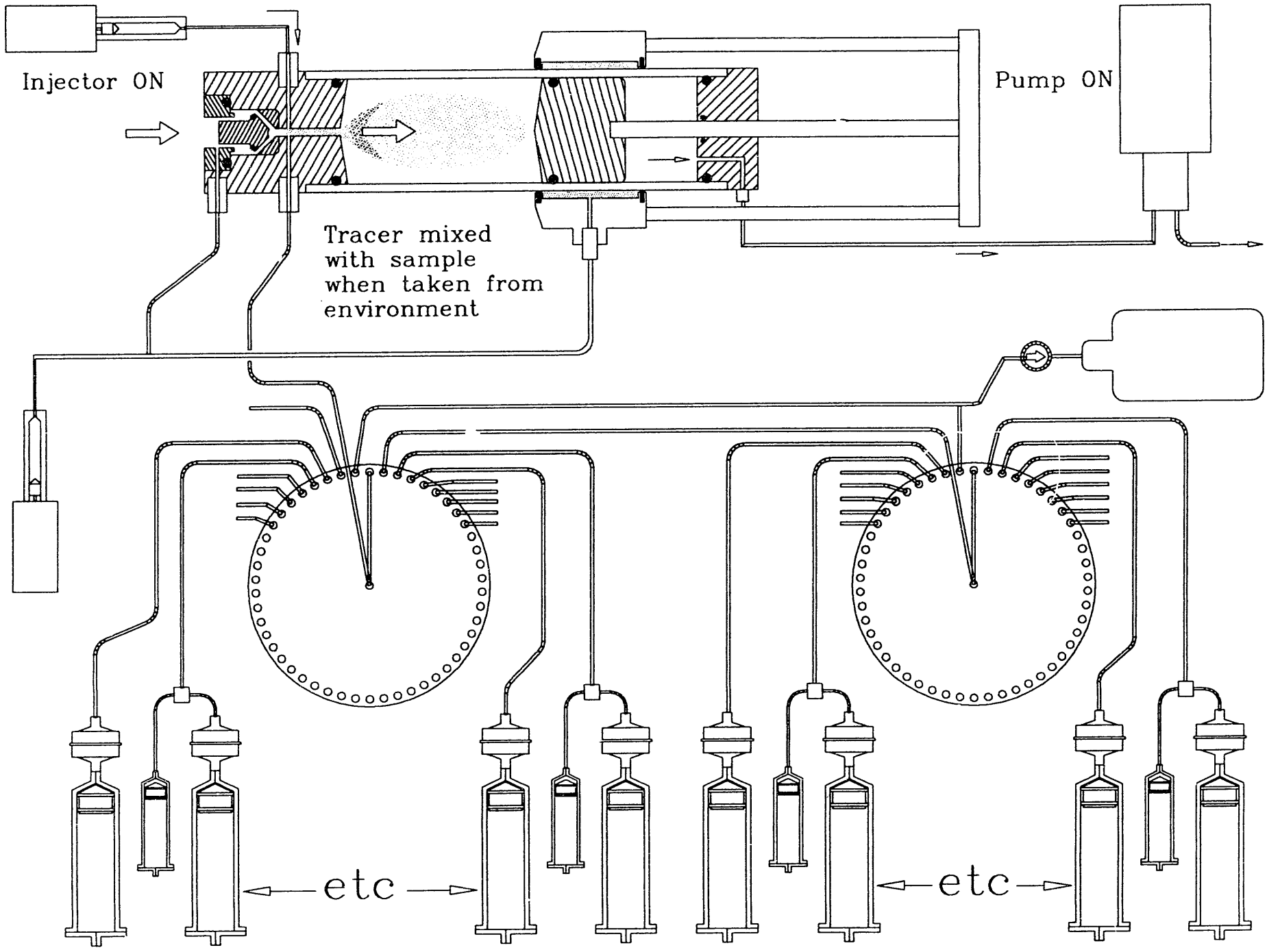
Panel A, Deployed configuration; Panel B, procurement of sample for incubation and simultaneous introduction of tracer; Panel C, Subsampling; Panel D, biofouling protection of interior surfaces by introduction of acid. During the first portion of the deployment, SDV-2 will remain quiescent in the "home" position until all of the subsamples controlled by DSV-1 have been taken. During the remainder of the deployment the valves are sequentially activated for distribution of subsamples into the remaining banks of subsampling syringes.

Biofouling protection and cleaning of all internal surfaces in contact with sample are effected by injection of acid into the throat of the incubation chamber check valve while seawater is drawn into the incubation chamber (Panel D). The HCl injector is identical to the tracer injector, but has a larger syringe system to contain the acid. The acid reservoir and wiping action of the biofouling control collar will be used for control of external fouling of the incubation chamber without the use of poisons.



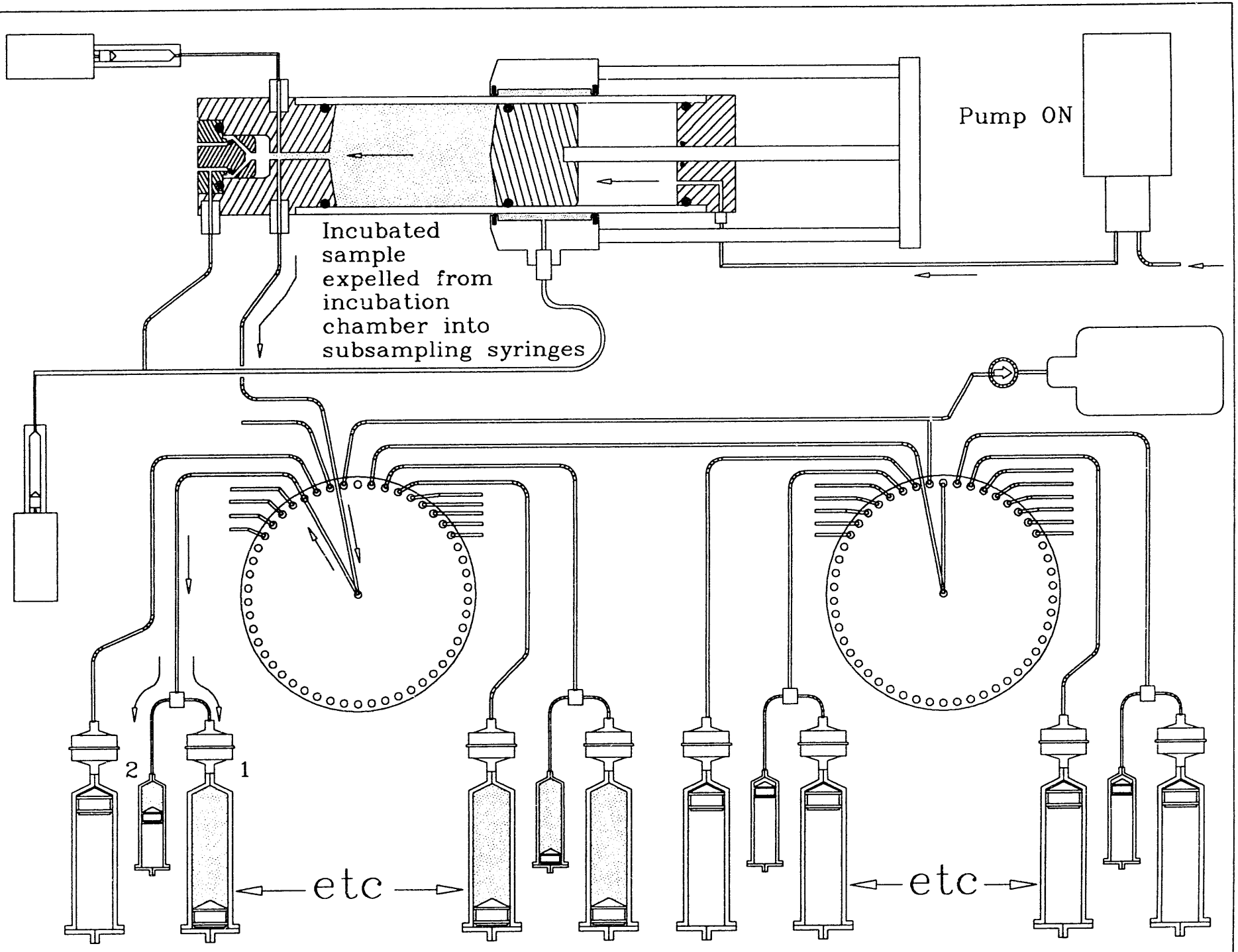
Time Series Submersible Incubation Device

A



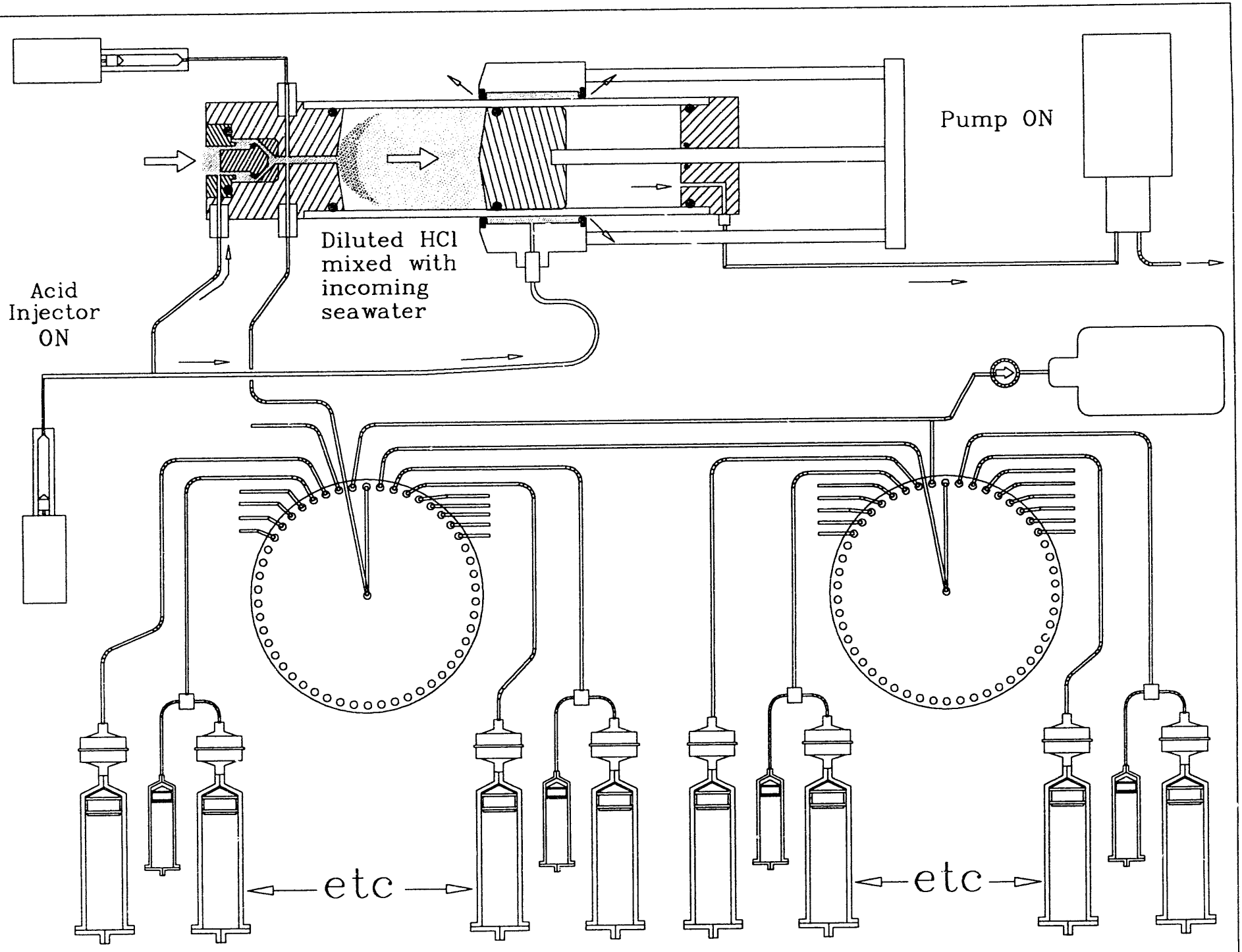
Taking Main Sample

B



Subsampling

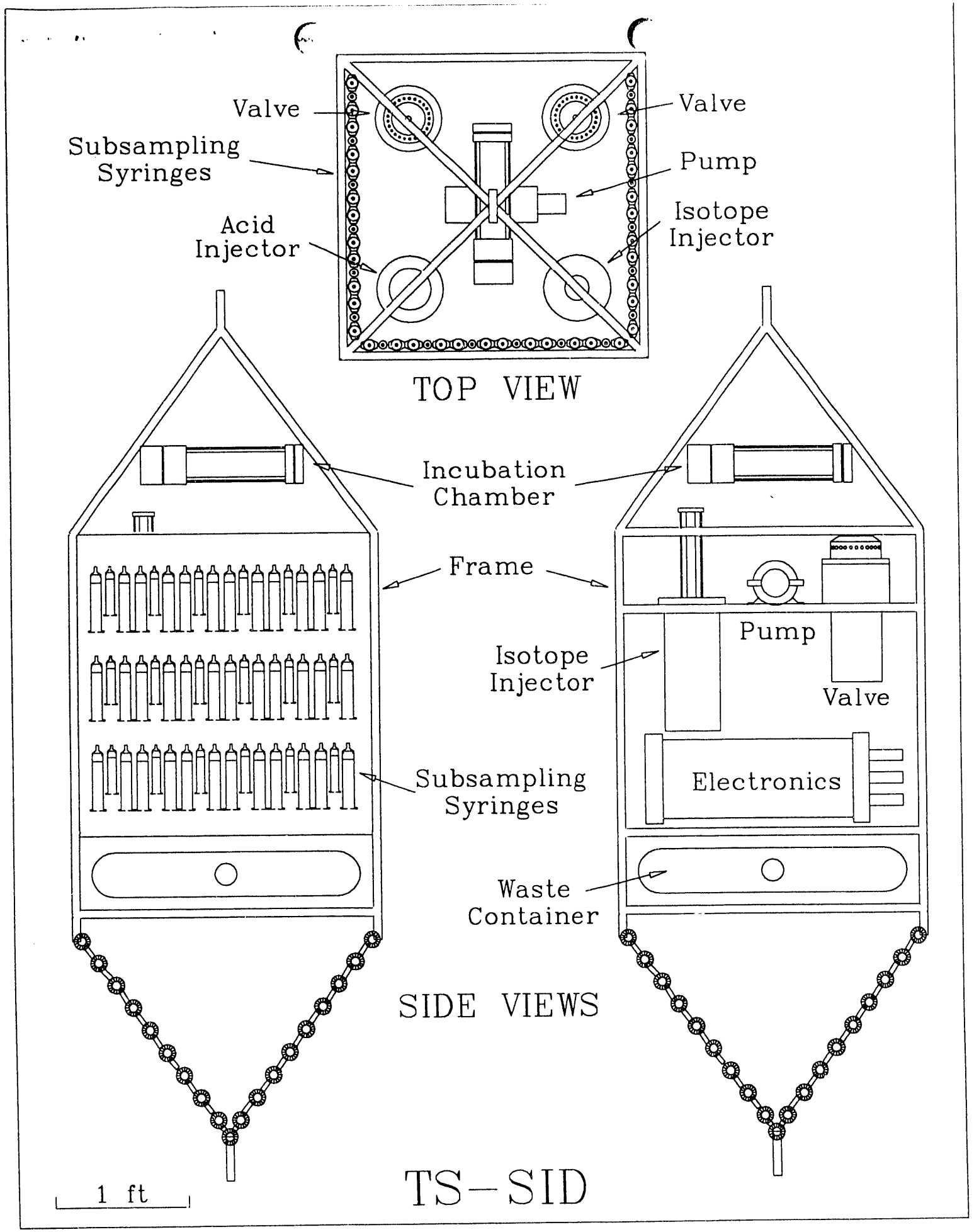
c



Biofouling Control

D

Figure 2. Arrangement of TS-SID modules within the mooring strength titanium frame. Side view left, view showing subsampling array; Side view right, subsampling array removed to show location of major components.


Valve
Valve
Subsampling Syringes
Pump
Isotope Injector
Acid Injector
TOP VIEW
Incubation Chamber
Frame
Pump
Isotope Injector
Valve
Electronics
Subsampling Syringes
Waste Container
SIDE VIEWS
1 ft
TS-SID

END

DATE FILMED

4/19/93