The stream of input words arrives in the computer by data interrupts interspersed every 16 ms by a program interrupt. The words are stored sequentially in the main input list by using a pointer which is accessible to both hardware and software. This pointer is inspected during program interrupts and its value is stored in an index table. At any time the index contains a complete description of the data which is stored in the main input list. Both the main list and its index are filled cyclically the input data rate will fluctuate but index entries will be inserted regularly every 16 ms [see Fig. 5]

The programs which are analysing the sonar data obtain new information through the index table. It is necessary to keep two pointers to the index table, the first is used by the interrupt program to mark the position of the newest entry and the second by the processing programs to mark the entry which is next due for processing.

The interrupt program inspects these pointers and if temporary overloading is about to occur it will change the pointer which is used by the processing programs so that the stalest data is abandoned.

The details of the software will not be discussed here, in any case there is more than one satisfactory treatment, but the principles which have guided the software design will be enumerated.

Firstly, the interrupt program must not be affected by the content of the input data words. If this is not so then there is a risk that faulty input could cause unexpected actions (e.g., endless loops) in the interrupt program.
Secondly, the converse should also be true, that is the data words should not be changed by the interrupt program, it is advisable to allow the input words to remain unchanged in a cyclic list for as long as possible as an aid to fault diagnosis.

Thirdly, the interrupt programs must not rely on the processing programs to work correctly. Even if the processing programs fail to take any more input data the interrupt programs should continue to run.
DIGITAL RECORDING FORMAT

36 in/s  556 BITS/in  7 TRACK (6 DATA + PARITY)

BEAM 0  BEAM 1  BEAM 7  BEAM 0  BEAM 1  BEAM 6  BEAM 7

20 BYTES  20 BYTES  16 BYTES

6-BIT AMPLITUDE SAMPLES

6-BIT PER SAMPLE

6 BITS AMPL.

8 SAMPLES

6-BIT AMPLITUDE

6-BITS PHASE

8 SAMPLES

INTER-PING GAP

POST DETECTION INTEGRATED SAMPLES

8 ms

16 ms

BASIC SAMPLES

FIG. 1

WORD FORMATS

DATA WORD  24 BITS

S.I.C. 1

<table>
<thead>
<tr>
<th>23 22 21 20 19 18</th>
<th>17 16 15 14 13</th>
<th>12 11 10 9 8 7 6 5</th>
<th>4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEAM NO.</td>
<td>AMPLITUDE</td>
<td>PHASE</td>
<td></td>
</tr>
</tbody>
</table>

DATA WORD

<table>
<thead>
<tr>
<th>23 22 21 20 19 18</th>
<th>17 16 15 14 13</th>
<th>12 11 10 9 8 7 6 5</th>
<th>4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEAM NO.</td>
<td>PHASE</td>
<td>AMPLITUDE</td>
<td></td>
</tr>
</tbody>
</table>

RANGE INCREMENT WORD

S.I.C. 2

<table>
<thead>
<tr>
<th>23 22 21 20 19 18</th>
<th>17 16 15 14 13</th>
<th>12 11 10 9 8 7 6 5</th>
<th>4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE SCALE</td>
<td>SHIPS SPEED</td>
<td>SHIPS BEARING</td>
<td></td>
</tr>
</tbody>
</table>

PROGRAM INTERRUPT STATUS WORD

CONTROL WORD FROM COMPUTER

<table>
<thead>
<tr>
<th>23 22 21 20 19 18</th>
<th>17 16 15 14</th>
<th>13 12 11 10 9 8 7 6</th>
<th>5 4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>START BEAM</td>
<td>FINE BEARING</td>
<td>OWN DOPPLER</td>
<td>THRESHOLD</td>
</tr>
</tbody>
</table>

FIG. 2
VIDEO TAPE SYSTEM

FIG. 3

WRITE CLOCK
SYNC. GEN.
+ SERIAL OUT
VIDEO TAPE RECORDER
SYNC. SEP.
SERIAL CLOCK
DATA OUT
DATA IN
SHIFT REG.
6 BITS + PARITY

COMPARISON OF RECORDING SYSTEMS

<table>
<thead>
<tr>
<th></th>
<th>DIGITAL</th>
<th>VIDEO</th>
<th>INSTRUMENTATION /DIGITAL</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPE SPEED</td>
<td>36</td>
<td>7</td>
<td>30</td>
<td>Inches/s</td>
</tr>
<tr>
<td>BIT DENSITY</td>
<td>0.12</td>
<td>0.56</td>
<td>2.88</td>
<td>Megabits/s</td>
</tr>
<tr>
<td>RECORD TIME</td>
<td>13</td>
<td>70</td>
<td>16</td>
<td>Minutes</td>
</tr>
<tr>
<td>(2400 ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAPE WIDTH</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
<td>Inches</td>
</tr>
<tr>
<td>TAPE COST</td>
<td>£50</td>
<td>£20</td>
<td>£50</td>
<td>Per Hour</td>
</tr>
</tbody>
</table>

FIG. 4

DATA STRUCTURE

INDEX

DATA

OUTPUT POINTER

INPUT POINTER

OLD DATA

BEING PROCESSED

TO BE PROCESSED

SECTION NOW BEING FILLED

POINTER USED IN DATA INTERRUPTS

INPUT STREAM

FIG. 5