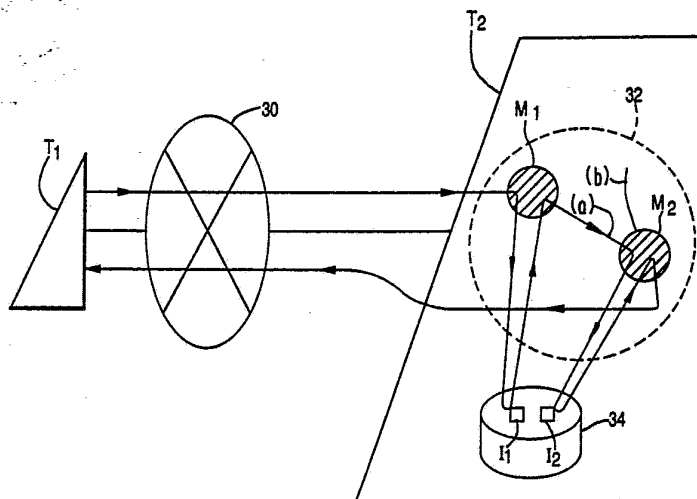




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| (51) International Patent Classification ⁵ : G06F 9/44, 9/46 | A1 | (11) International Publication Number: WO 91/10191 (43) International Publication Date: 11 July 1991 (11.07.91) |
| (21) International Application Number: PCT/JP90/01680 (22) International Filing Date: 21 December 1990 (21.12.90) (30) Priority data: 1/337031 26 December 1989 (26.12.89) JP 1/337032 26 December 1989 (26.12.89) JP (71) Applicant (for all designated States except US): FUJITSU LIMITED [JP/JP]; 1015, Kamikodanaka, Nakahara-ku, Kawasaki-shi, Kanagawa 211 (JP). (72) Inventors; and (75) Inventors/Applicants (for US only) : AOE, Shigeru [JP/JP]; 5-3-11-702, Yashio, Shinagawa-ku, Tokyo 140 (JP). KAKEHI, Gen [JP/JP]; 20-9-101, Edaminami 5-chome, Midori-ku, Yokohama-shi, Kanagawa 227 (JP). RYU, Tadimitsu [JP/JP]; 1-604, Konandai Kotohausu, 1151-121, Kamigocho, Sakae-ku, Yokohama-shi, Kanagawa 247 (JP). | | (74) Agent: IGETA, Sadakazu; Fujitsu Limited, 1015, Kamikodanaka, Nakahara-ku, Kawasaki-shi, Kanagawa 211 (JP). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i> |

(54) Title: OBJECT ORIENTED DISTRIBUTED PROCESSING SYSTEM**(57) Abstract**

A system for distributing processing between terminals ($T_1 \sim T_n$) connected via a communication network (30). Each terminal (T_i) is provided with at least one method group (32) and a memory unit (34) to store data files. An originating terminal, e.g., terminal (T_1) accesses data elsewhere in the distributed system by generating a message. The message includes a terminal code identifying an object to access a terminal (T_2) to execute an object, a method code identifying a method for accessing the data and a command name containing or identifying the desired data. The terminal, e.g., terminal (T_2), containing the desired data, decodes the message and accesses a data file in the memory unit (34) containing the desired data identified by the command name. The message may also include a selector and reset conditions which control the sequence of data processing in the terminals (T_0 and T_n) so that the processing of the originating (T_1) and data accessing (T_2) terminals can be coordinated. When the processing identified by the method code is completed in the data accessing terminal (T_2), a message including the resulting data is sent from the data accessing terminal (T_2) to the originating terminal (T_1). Objects according to the present invention may contain a method without data and may be transmitted from one terminal to another as data. Thus, any application or operating system program can be replaced or added by transmitting an object containing that program as data.

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DESCRIPTION

OBJECT ORIENTED DISTRIBUTED PROCESSING SYSTEM

5 Technical Field

The present invention is directed to object oriented distributed processing in a system of computers at terminals connected by a communication network and, more particularly, to communication between objects stored and executed in the terminals to perform processing of software.

10Background Art

In conventional distributed data processing systems, if a first terminal requires data stored in a second terminal, the first terminal requests the data and the second terminal transmits the data to the first terminal so that the first terminal can process the data. The transmission of raw data which is typically higher in volume than processed data requires a high capacity communication network and limits the number of terminals which can be connected together before significantly reducing overall throughput of the system.

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Large distributed processing systems contain a large number of terminals, each having its own computer system. When changes are made to the operation of the distributed processing system, the computer system at each terminal must be updated. Most conventional distributed processing systems do not have the capability to update the operating system of the computer systems at the terminals via the communication network.

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In computer systems using object oriented architecture, abstracted data (instance) and a program (method) specifying processing of the data are together treated as an object. Data processing is carried out by processing the methods in such objects and communicating messages therebetween. In object oriented processing,

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wherever the data is located, procedures for processing the data will be located also. Execution of these procedures is triggered by message transfer between objects, including the transmission of resulting data in messages after processing of data in an object is completed.

Applying object oriented techniques to a distributed data processing system is not easily accomplished due to the need to maintain the linkage between data and method of an object, to determine where an object is located and to communicate between objects. One way of implementing object oriented techniques in a distributed processing system is to maintain a database in each terminal of the objects in all of the terminals. In a large system, this requires a large amount of overhead due to the size of the memory required and the time and communication traffic required to update the object location database in each of the terminals.

An object of the present invention is to provide object oriented processing in all terminals of a distributed processing system, executed as if in a single processing system.

Another object of the present invention is to provide a system for distributed data processing in which objects can be obtained by one terminal from another terminal without maintaining an object location database in all terminals.

A further object of the present invention is to provide a distributed processing system capable of transmitting changes to the operating system programs of the distributed processing system to the terminals via the communication network of the distributed processing system.

Yet another object of the present invention is to provide a method for linking objects regardless of their location or content.

DISCLOSURE OF INVENTION

In a distributed processing system having a plurality of terminals connected via a communication network, object oriented processing is performed by communicating via messages containing a terminal code, a method code identifying processing of data and a command containing data or identifying data in an object to be processed. The method identified by the method code is executed by the terminal identified by the terminal code. Messages may contain multiple submessages, where each submessage includes a terminal code, a method code and a command. The command may identify an object in one terminal which is to be installed in the terminal identified by the terminal number. This object may be a new program or a replacement for an existing program in the terminal identified by the terminal number. The program may be an application program or an operating system program. Objects may contain methods without data, thereby permitting any type of program to be updated.

The terminal code may identify an object for transmitting the message to the terminal where the object identified by the object code is located. If the terminal code is zero or null, the object will be looked for in the terminal in which the object generating the message is executing. If the terminal number is unknown, the object identified by the terminal code will identify an object which will perform processing to locate the object in one of the other terminals on the system.

The command in the object code may include a selector condition and a reset condition for identifying how the method identified by the method code is to be initiated and how to proceed when the sequence starting with the method identified by the method code has completed execution, respectively. The command code

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may contain a message for identifying an object for obtaining data for the method identified by the method code to process in the terminal identified by the terminal code.

5 These objects, together with other objects and advantages which will be subsequently apparent, reside in the details of constitution and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, 10 wherein like reference numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 is a block diagram of a distributed processing system to which the present invention can be applied;

 Fig. 2 is a block diagram of one of the terminals;

 Fig. 3 is a chart of the command link and sequence files;

20 Fig. 4 is a flowchart of processing to locate an object according to the present invention;

 Fig. 5 is a flowchart of processing to update a program in a remote terminal;

25 Fig. 6 is a flow diagram of object sequencing in the prior art;

 Fig. 7 is a conceptual block diagram of processing in a terminal having an object required by another terminal and illustrating the use of common objects;

30 Fig. 8 is a flow diagram of object sequencing using common objects according to the present invention;

 Fig. 9 is a flowchart of sequencing using common objects according to the present invention; and

 Fig. 10 is a flowchart of processing using common objects according to the present invention.

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BEST MODE OF CARRYING OUT THE INVENTION

As illustrated in Fig. 1, a plurality of terminals T_0 ~ T_n are connected via a communication network 30, such as a local area network (LAN), intelligent network (IN), integrated services digital network (ISDN). In the case of ISDN, a dedicated line is preferably used for carrying supervisory information, while object commands and responses thereto are communicated by ISDN. Each terminal T_i has program modules stored in method groups 32 and data stored in a data file 34. An object executes in one of the terminals by executing the program stored in one of the method groups and identified as being the method for that object. When the method is instructed to begin execution of another object, e.g., to obtain data from the second object, a message is generated having the general format G below

$$G = \{(T_i: M_j, I_k); (T: M_m, I_n); \dots\},$$

where T_i is a terminal code, M_j a method code and I_k the name of an instance and any one or two of the (T_i , M_j and I_k) may be missing, as described below.

Each terminal T_i includes the components illustrated in Fig 2. A system interface 40 is connected to the communication network 30. A processor 42 receives input from an operator via an input device 44 which may be a keyboard or other peripheral, including graphic tablet, tape or floppy disk drive, etc. An output device 46, such as a CRT display, printer, the tape or floppy disk drive, etc., provides output to the operator. The objects (methods and instances) are stored in a memory unit 48, such as a hard disk drive, and are addressed by a system table 50 which may be stored in the memory unit 48 and in random access memory (not shown) in the processor 42. An example of a commercial embodiment of

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the terminal illustrated in Fig. 2 is a personal computer.

The system table 50 is one of the most important tables in each terminal T_i . As illustrated in Fig. 3, the system table includes part of a command link file 52 and all of a sequence file 54. The command link file 52 stores the location and size of all objects stored in the memory unit 48. The method entries 56 in the command link file 52 are included in the system table because they identify the programs which constitute and can be executed by the system controlling the operation of the terminal T_i . The command link file 52 also includes instance entries 58 which identify the location and size of data stored in the memory unit 48.

When the message G above is received by terminal T_i , the object may be interpreted method M00003 and instance I00003. The processor 42 can retrieve the method M00003 and instance I00003 by accessing the system table 50 to determine their address and size, as indicated by the dashed lines in Fig. 2.

The command link file 52 permits the same block of code or data to be used in more than one object. In the example illustrated in Fig. 3, methods M00001 and M00004 have the same address and size. However, the instances, I00001 and I00004, forming objects with these methods are stored in different locations, although they are the same size. Thus, the same method (stored at address A00007482) can be used to process different data, depending on which name (M00001 or M00004) is used. Similarly, the same data can form different objects by being combined with different methods. For example, one method may transfer data to or from the terminal T_i , while another method processes the same data in the terminal T_i .

When a new object is to begin control of the processor 42, the processing illustrated in Fig. 4 is

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executed. First, the new object name is stored 60 in an object management table. Next, the terminal number associated with this object in the message controlling the triggering of the new object, is compared 62 with
5 the terminal number, e.g. T_1 , of the terminal performing this process. If there is a match and the address in the command link file 52 indicates the method is stored in terminal T_1 , the object is moved 64 from the memory unit 48 to the execution area (not shown) in the
10 processor 42. When the terminal number associated in the message with the new object name does not match 62 the terminal number of the terminal performing this process or the address of the method and instance of an object refer to another terminal as indicated for object
15 000003 (method M00003 and instance I00003), a message is sent 66 to the terminal, e.g. T_2 , identified in the message or address field of the command link file to trigger the object in that terminal (T_2). This is done
20 by triggering an object with the same name as the terminal number (T_2) in the terminal T_1 , executing the process illustrated in Fig. 4.

When the terminal number indicates that the terminal in which the object to be executed is unknown, first the system table 50 of the terminal (T_1) executing the
25 process is checked 68 for the object name. If the object name is found 70, the object is moved 64 to the execution area of the processor 42. If the object name is not found 70, an object is triggered to access a master system file. The master system file keeps a
30 record of the location of all objects. The master system file may be located in the communication network 30 or in one of the terminals (a server). Alternatively, a copy of the master system file may be located in each of the terminals. However, this last
35 alternative requires a significant amount of overhead to maintain the master system file.

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When an object is located in a different terminal, the object may be executed there or transferred to another terminal, including a terminal requesting its execution. In the preferred embodiment, when an object
5 not presently stored in a terminal is desired to be executed, the object will be executed in the terminal in which it is stored. To provide other terminals with an object stored in terminal T_1 , for example, the processing steps illustrated in Fig. 5 are executed. This process
10 is termed a learning method and may be used to transfer any application programs or system programs when all are in the form of objects.

As illustrated in Fig. 5, when an object transfer request is received 74 by terminal T_1 , e.g. via the
15 input device 44, the requested object is accessed 76 in memory unit 48 via the system table 50. The object is decomposed 78 in byte data for transfer 80 as an entity to the second terminal, e.g. terminal T_2 . Depending upon the type of transfer request received, the entire object
20 may be transferred 80 after decomposition, or only the method or data in the object. The requested portion or entirety of the object is transferred 80 by transmitting a message including the object (or portion thereof) as entity data. Terminal T_2 receives 82 the message
25 including the entity data, composes 84 the object for installation and stores 86 the object in the memory unit 48 in terminal T_2 . In addition, the system table 50 in terminal T_2 is updated 86 with the object name. If the object name previously existed in the system table, the
30 address and (if necessary) size of the object will be updated to reflect the object just stored.

The sequence file 54 (Fig. 3) enables predefined sequences of methods to be stored in the system table 50. As an alternative to the message format G above, a
35 simplified message format G_i may be used, where sf_i is

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$$G_1 = \{T_i:O_i, sf_i; T_{i+1}:O_{i+1}, sf_{i+1} \dots\}$$

a sequence flag indicating that the preceding object name is a sequence number which should be looked for in the sequence file 54. For example, if O_i in G_1 is S00001, methods M00001, M00003 and M00005 will be executed in sequence. In a first alternative embodiment, the object name may identify a method and the command fields of the sequence file 54 will be searched for the corresponding method name when the sequence flag is set. In this embodiment, each method may be limited to a single entry in the sequence file or some rule, such as first occurrence in the file may be used to find the right sequence. In this case each method may appear in as many sequences as desired, but should start only one sequence. In a second alternative embodiment, the sequence flag may be a sequence number identifying the starting point of the sequence. In this embodiment, the object name can be used to access the first method and instance while the sequence is being determined.

Another way of sequencing objects according to the present invention is to use common objects. In the prior art, the only way to sequence objects was to link one object to the next as illustrated in Fig. 5. According to the present invention, messages may have the format G_2 including a selector condition s_i and a

$$G_2 = \{T_i:(O_i, s_i, r_i); T_{i+1}:(O_{i+1}, s_{i+1}, r_{i+1}) \dots\}$$

reset condition r_i . According to the present invention, common objects permit the same object to be used in different ways by different objects and to predefine a variety of sequences in the common objects themselves instead of in a sequence file. The selector condition

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s_i defines an entry point in the common object O_i . The reset condition r_i defines how the sequence ends.

It should be noted that common objects are not limited to use in forming sequence objects. Sequence objects have a defined structure with a beginning and end. On the other hand, common objects have a defined function and can be executed whenever that function is required. For example, common objects can be used in the kernel of an operating system to perform functions whenever needed.

A very simple example of the use of common objects in sequence will be provided first with reference to Fig. 7 and message G_3 below. The beginning of message G_3 instructs

$$G_3 = \{T_2:O_1; T_2:(O_2, a, r)\}$$

terminal T_1 that objects are to be executed in terminal T_2 and so message G_3 is transmitted to terminal T_2 by executing an object called T_2 in terminal T_1 . Terminal T_2 decodes the message G_3 to determine that for the first object O_1 method M_1 is to be executed using the data in instance I_1 and then a second object O_2 is to be performed using method M_2 , by entering at (a), as identified by the selector condition a. The data in instance I_2 is processed by method M_2 and then processing returns to terminal T_1 , as identified by the reset condition r. No selector or reset condition is provided for object O_1 , because there is a single entry and exit point for object O_1 .

An example of a few sequence objects 90 and common objects 92 are illustrated in Fig. 8. Common objects O_A , O_B , and O_C have three entry points, a, b and c, and three exit points, but common object O_C has an extra entry point and common object O_D has only one entry and exit point. Processing of the common objects

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illustrated in Fig. 8 will be discussed with reference to the flowchart illustrated in Fig. 9.

First taking as an example the sequence initiated by sequence object O_1 , common object O_A is triggered with selector condition a and a reset condition to return to the originating object (O_1). Since the selector condition is a, the selector condition matches in the test 94 for condition a, and the appropriate condition steps 96 are executed. After any common steps 98 are executed, it is determined 100 whether a new common object should be triggered. As indicated by the dashed line across object O_A from entry point a, in this example, common object O_B is to be triggered 102 with selector condition a. The reset condition is passed on in the message which triggers common object O_B . The same steps of Fig. 9 are executed in common object O_B and a message is generated to trigger common object O_C with selector condition b and the same reset condition.

In common object O_C , it will be determined 94 that the selector condition is not a, but a match will be found in the test 104 for selector condition b. Therefore, the steps 106 for condition b will be executed prior to the common steps 98. As indicated by the dashed line entering common object O_C at b, it will be determined 100 that there are no more common objects to be executed and so the reset condition will be tested 108. As noted above, the reset condition in the message generated by sequence object O_1 was to return to the originating object. This reset condition is passed to common object O_C and therefore processing will return 110 by referencing the object management table to determine the originating object.

Processing of the other sequences illustrated in Fig. 8 is similar. The sequence originating with sequence object O_2 uses selector condition b in common object O_B and proceeds to use the same selector condition

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in common object O_A . At the end of the sequence, common object O_c is triggered with selector condition a. The reset condition in the originating message from sequence object O_2 indicates that a new sequence object O_3 is to be triggered 112 by the final common object O_c in the sequence. The sequence originating in sequence object O_4 passes through common objects O_B and O_0 before terminating 114 in common object O_c .

An example of the use of common objects is provided in the flowchart illustrated in Fig. 10. The operations of sequence objects appear on the left side of Fig. 10, while the operations of common objects appear on the right. One or more sequence objects are used to receive and initiate transfer 120 of data to a common object. Thus, unique input routines are used to interface with an operator or a peripheral device inputting application specific data. A common object is used to store 122 the data. The common object transfers 122 a command name, identifying the data, to a sequence object. The sequence object fetches the command and processes 124 as required by the application. If it is determined 126 that editing is necessary, general purpose editing routines stored as one or more common objects can be used to edit 128 the data.

After any necessary editing, it is determined 130 whether any existing entity data is needed. If so, a command name is transferred 132 to another common object which extracts 134 the entity data and converts command names to entity data. Processing is continued by a sequence object which fetches 136 the entity data and performs additional processing. According to the present invention, commonly executed routines can be stored as common objects, but flexibility in the order in which they are executed and details of how they are executed is provided.

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INDUSTRIAL APPLICABILITY

The present invention relates to a distributed data processing system and particularly to a system for realizing distributed object oriented processing between terminals connected via a communication network. In a database system which is required to provide sophisticated functions for diversification of application modes in which a plurality of terminals are connected via a communication network, the man-hours required for system development increase as more sophisticated functions are added. A system with improved processing speed and reduced communication traffic requiring less development time is provided.

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CLAIMS

What is claimed is:

1. A distributed processing system, comprising:
 - a communication network to transmit messages,
5 including data; and
 - a plurality of terminals connected together by
said communication network, each terminal capable of
generating the messages, each of the messages having a
terminal number for identifying one of the terminals to
10 receive the message, a method code identifying
processing of data and a command for identifying data to
be processed.

2. A distributed processing system as recited in
15 claim 1, wherein each of said terminals comprises:
 - a memory unit to store objects, including
methods and instances;
 - a processor, operatively connected to said
communication network, to execute the methods stored in
20 said memory unit; and
 - a system table to store identifying information
on the location and execution sequence of the methods
stored in said memory unit.

- 25 3. A distributed processing system as recited in
claim 1, wherein each of said terminals comprises:
 - a memory unit to store objects, including
methods, at least one of the objects including a
learning method;
 - 30 a processor, operatively connected to said
communication network, to execute the methods stored in
said memory unit; and
 - a system table to store identifying information
on the location and execution sequence of the methods
35 stored in said memory unit, said processor updating said
system table and the contents of said memory unit upon

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receipt of one of the messages from another terminal instructing said processor to execute the learning method stored in said memory unit.

5 4. A terminal in a distributed processing system, comprising:

 object storage means for storing objects, including at least one object including a method;

 system table means for storing identifying
10 information on location and execution sequence of the objects stored in said object storage means; and

 decomposing means for decomposing the method in one of the objects into byte data in response to a transfer request;

15 transfer means for transferring the byte data decomposed by said decomposing means to another terminal upon completion of the decomposing and for receiving an updated object requested to be transferred to said terminal; and

20 installation means for storing the updated object into said object storage means and for updating said system table means with an object name corresponding to the updated object.

25 5. A method for transferring programs in a distributed processing system executing objects in terminals, the objects inclusive of objects including a method, said method comprising:

 (a) receiving a transfer request at a first
30 terminal to transfer a selected object from the first terminal to a second terminal;

 (b) decomposing the selected object into byte data in response to the transfer request;

 (c) transferring the byte data decomposed in
35 step (b) to the second terminal upon completion of said decomposing;

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(d) receiving the byte data at the second terminal;

(e) composing the byte data to produce an updated object corresponding to the selected object requested to be transferred to the second terminal; and

(f) storing the updated object and an object name, corresponding to the updated object, in the second terminal.

10 6. A method as recited in claim 5, wherein said decomposing in step (b) comprises the step of selecting one of the method and data in the selected object for said transferring in step (c).

15 7. A method for processing messages in a distributed processing system having a plurality of terminals connected by a communication network, said method comprising the steps of:

20 (a) determining in a first terminal, for a first message identifying a first object, whether the first object is stored in the first terminal;

25 (b) triggering the first object in the first terminal when said determining in step (a) determines that the first object is stored in the first terminal; and

30 (c) generating a second message to a second terminal to locate the first object when said determining in step (a) determines that the first object is not stored in the first terminal.

35 8. A method as recited in claim 7, wherein all messages generated in the distributed processing system, including the second message generated in step (c), include a terminal number for identifying one of the terminals to receive the message, a method code

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identifying processing of data and a command for identifying data to be processed.

5 9. A method as recited in claim 8, wherein said determining in step (a) comprises comparing the terminal number identifying the first terminal with the terminal number in the first message.

10 10. A method as recited in claim 9, wherein said generating in step (c) comprises setting the terminal number in the second message equal to the terminal number in the first message when said comparing in step (a) determines that the terminal in the first message is not equal to the terminal number of the first terminal.

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11. A method as recited in claim 10, further comprising the steps of:

20 (d) storing method codes of each of the objects stored in each of the terminals in a command link file in each of the terminals, respectively, and all of the method codes for all of the objects stored in all of the terminals in a master system table;

25 (e) comparing the method code in the first message with the method codes in the command link file for the first terminal when said comparing in step (a) determines that the terminal number of the first message is unknown;

30 (f) executing step (b) when said comparing in step (e) determines that the method code in the first message is included in the message codes in the command link file for the first terminal; and

35 (g) generating a third message to access the master system table when said comparing in step (e) determines that the method code in the first message is excluded from the message codes in the command link file for the first terminal.

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12. A method as recited in claim 7,
wherein said generating in step (c) comprises
the step of (c1) generating the second message with a
subset of a second object, and

5 wherein said method further comprises the steps
of:

(d) storing command names associated with
each of the objects stored in each of the terminals in a
command link file in each of the terminals,
10 respectively;

(e) storing the subset of the second
object in the second terminal upon receipt of the second
message at the second terminal; and

(f) storing a subset command name,
15 corresponding to the subset of the second object, in the
command link file of the second object.

13. A method as recited in claim 12, wherein said
generating in step (c) further comprises the step of
20 (c2) decomposing the second object into byte data prior
to said generating in step (c1).

14. A method as recited in claim 13, wherein said
generating in step (c2) comprises the step of
25 transferring all of the byte data decomposed from the
second object into the second message.

15. A method as recited in claim 13, wherein said
generating in step (c2) comprises the step of transfer-
30 ring a method portion of the byte data decomposed from
the second object into the second message.

16. A method as recited in claim 7,
wherein all messages generated in the
35 distributed processing system, including the second
message generated in step (c), include a terminal number

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for identifying one of the terminals to receive the message and an object code, and

wherein said method further comprises the steps of:

5 (d) determining whether the object code includes a sequence file identifier; and

(e) executing sequence objects in a sequence determined by entries in a sequence file when said determining in step (d) determines that the object
10 code includes the sequence file identifier.

17. A method as recited in claim 7,

wherein all messages generated in the distributed processing system, including the second
15 message generated in step (c), include a terminal number for identifying one of the terminals to receive the message and an object code, and

wherein said method further comprises the steps of:

20 (d) storing common objects in at least one of the terminals;

(e) determining whether the object code includes a common object name, a selector condition and a reset condition;

25 (f) triggering a corresponding common object in dependence upon the common object name and the selector condition when said determining in step (e) determines that the object code includes the common object name, the selector condition and the reset
30 condition; and

(g) ending execution of the common objects in dependence upon the reset condition when said
35 determining in step (e) determines that the object code includes the common object name, the selector condition and the reset condition.

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18. A method as recited in claim 17, wherein said triggering in step (f) comprises the steps of:

(f1) comparing the selector condition with predetermined selector conditions in the corresponding common object; and

(f2) executing condition steps in the corresponding common object identified by one of the predetermined selector conditions in dependence upon said comparing in step (f1).

19. A method as recited in claim 17, wherein said ending in step (g) comprises the steps of:

(g1) returning to the first object when the first message was determined in step (e) to contain the common object name of one of the common objects and the reset condition is set to return;

(g2) triggering a new sequence object when the reset condition is set to trigger; and

(g3) terminating execution of the common objects without returning or triggering when the reset condition is set to terminate.

20. A message transmitted between objects in an object oriented distributed processing system having a plurality of terminals connected by a communication network, said message comprising:

a terminal number for identifying one of the terminals to receive said message;

a method code identifying processing of data;

and

a command for identifying data to be processed.

21. A message as recited in claim 20, wherein said command includes a sequence file identifier identifying a sequence defined in a sequence file for executing objects triggered by said message.

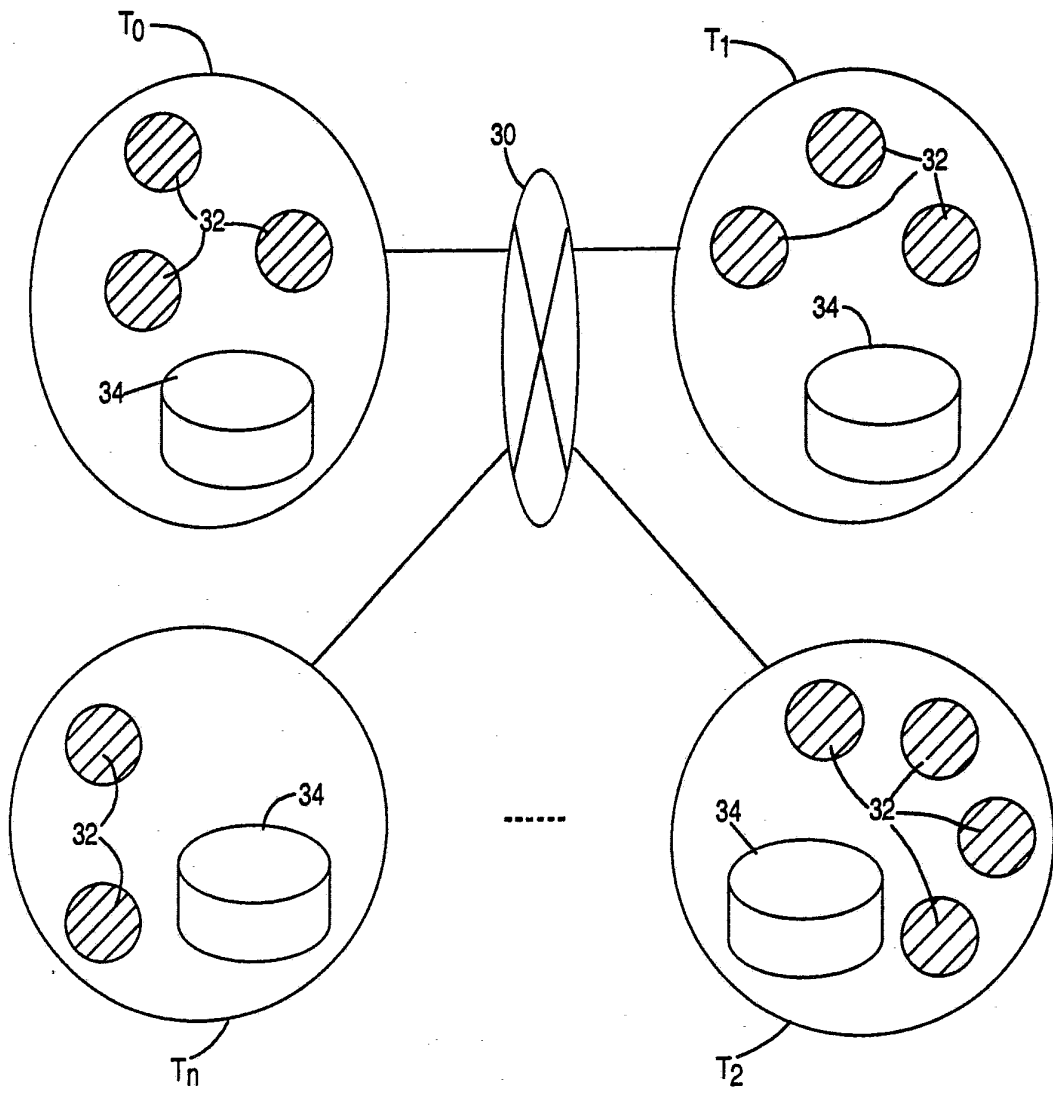
- 21 -

22. A message as recited in claim 20, wherein said
command includes a selector condition and a reset
condition when said method code identifies a common
object, the selector condition determining how the
5 common object executes and the reset condition
determining how execution of the common object and any
subsequent additional common objects ends.

23. A system table in an object oriented
10 distributed processing system having a plurality of
terminals connected by a communication network, said
system table comprising:

a method code portion of a command link file
including fields for method name, address and size; and
15 a sequence file including fields for sequence
number, command name and next sequence number.

FIG. 1



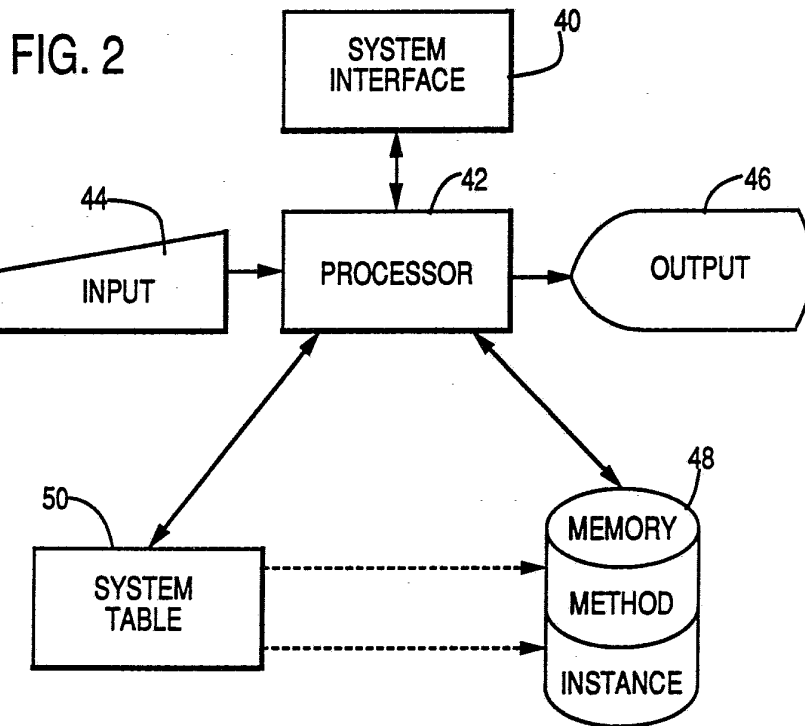


FIG. 3

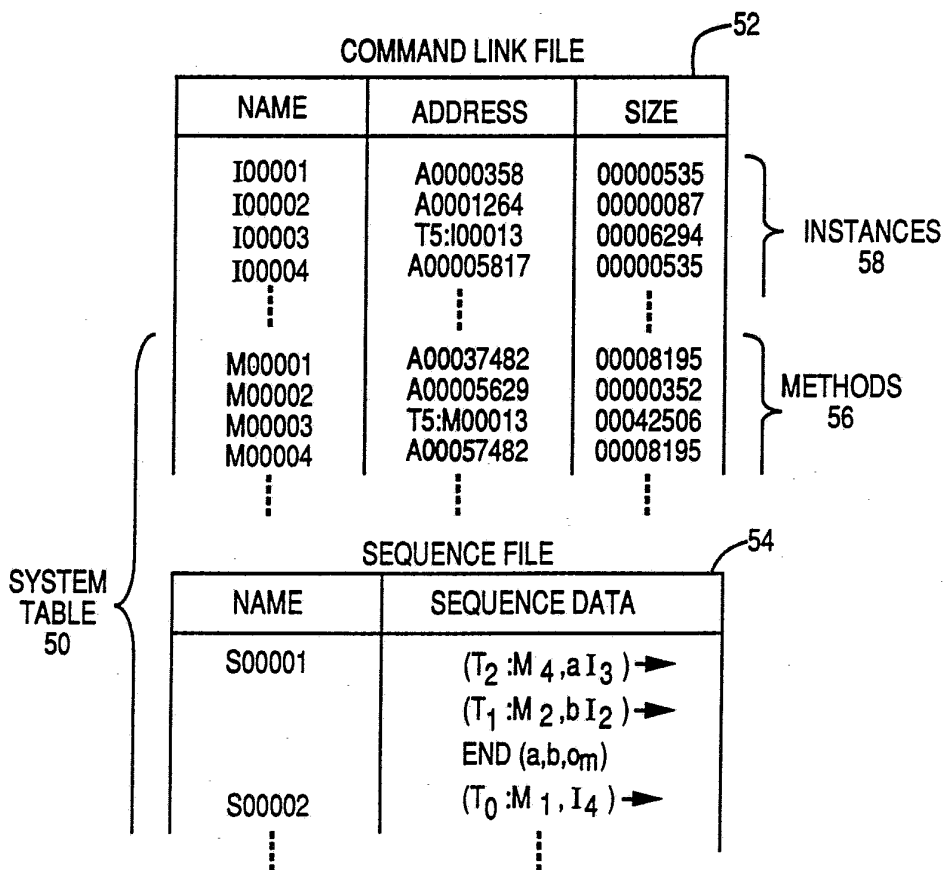


FIG. 4

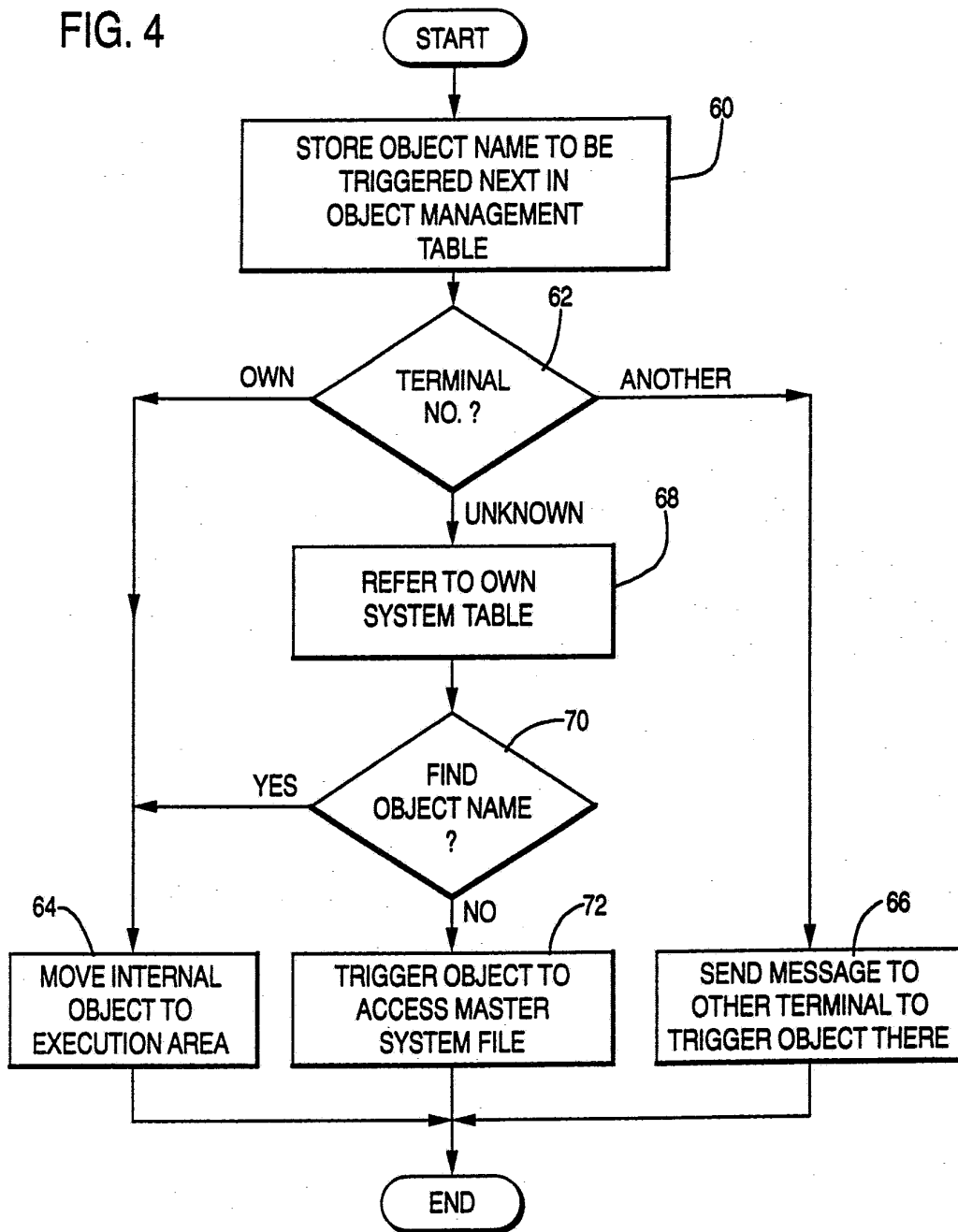
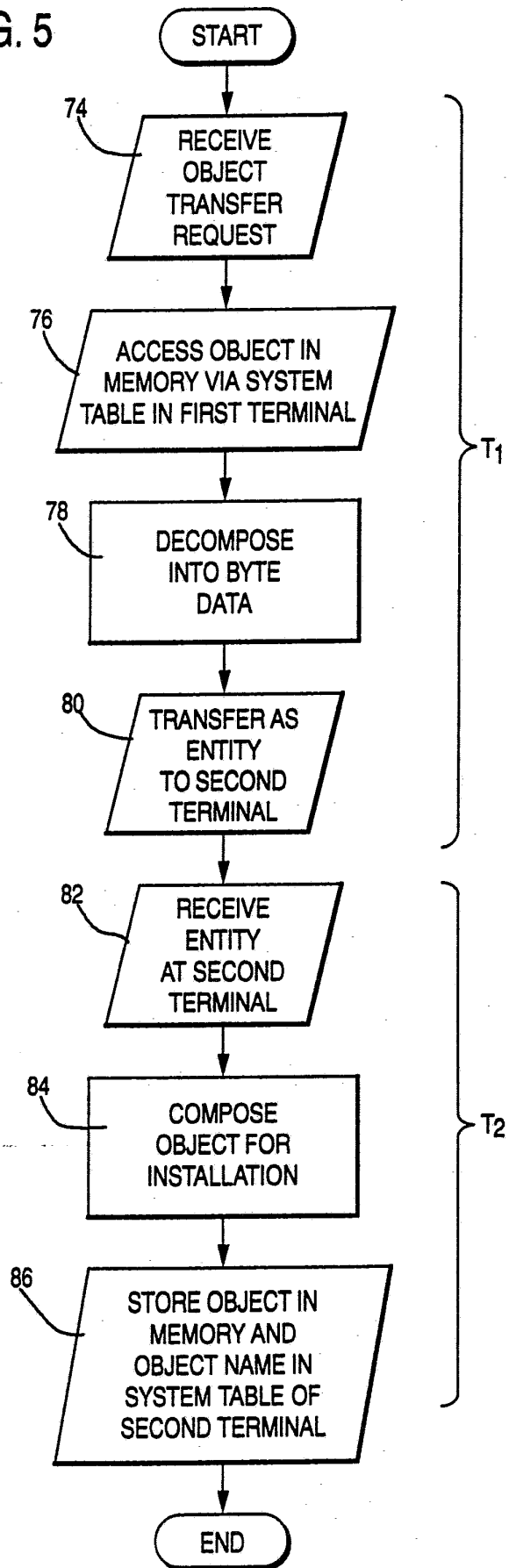


FIG. 5



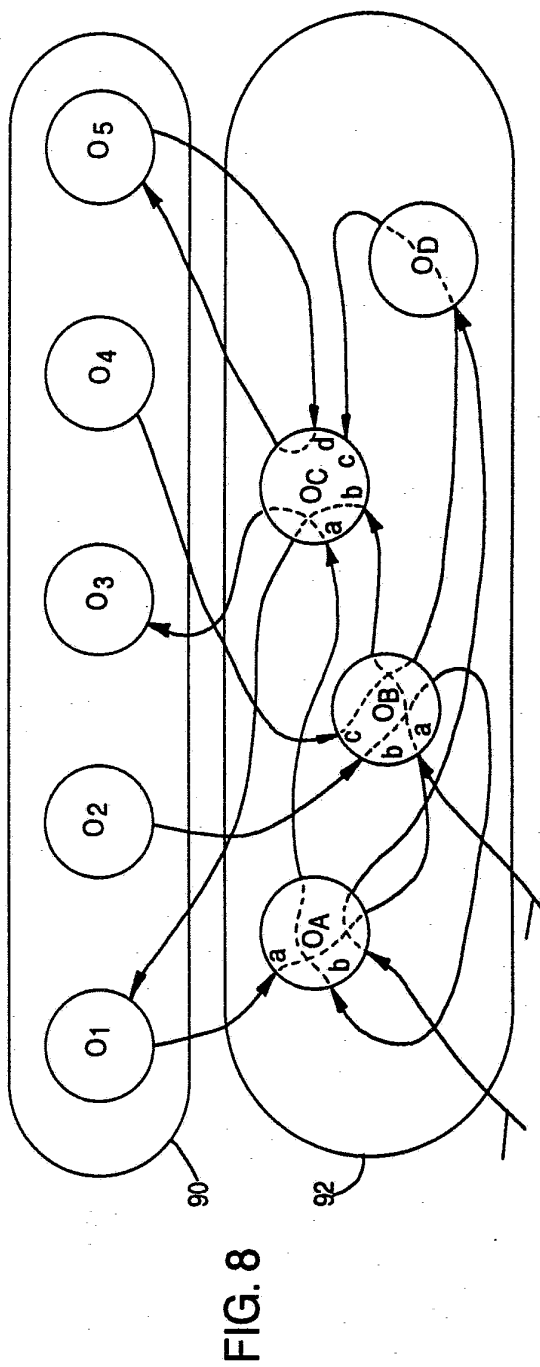
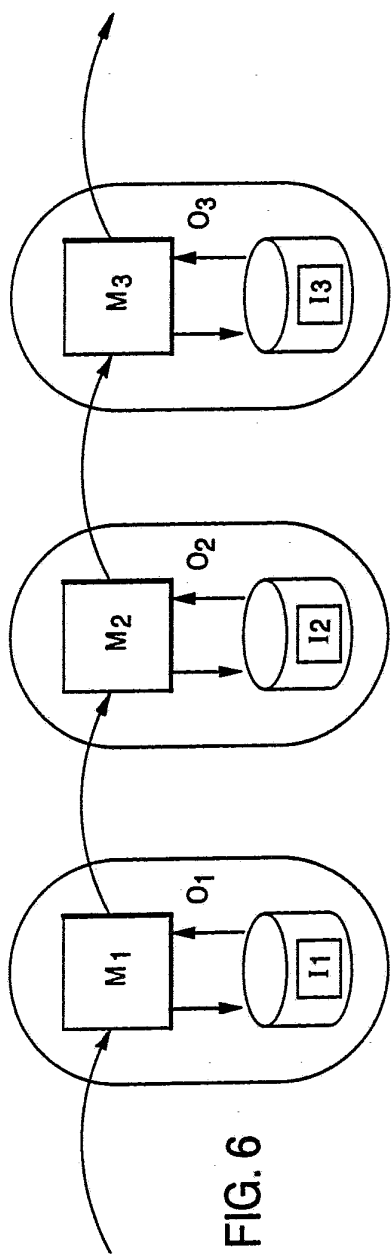


FIG. 7

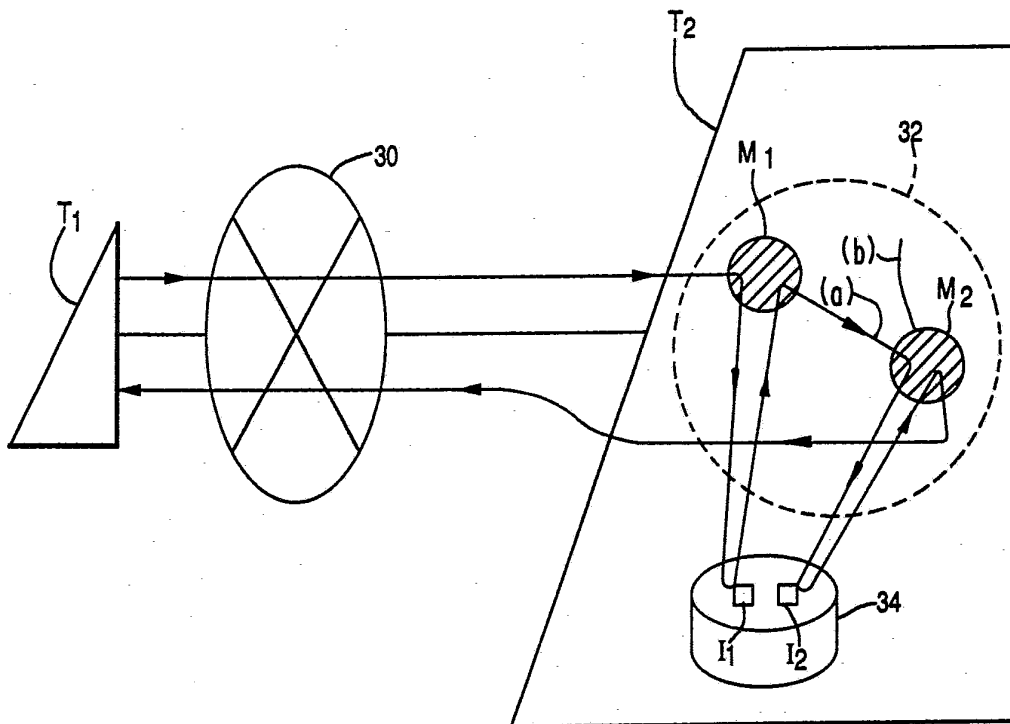


FIG. 9

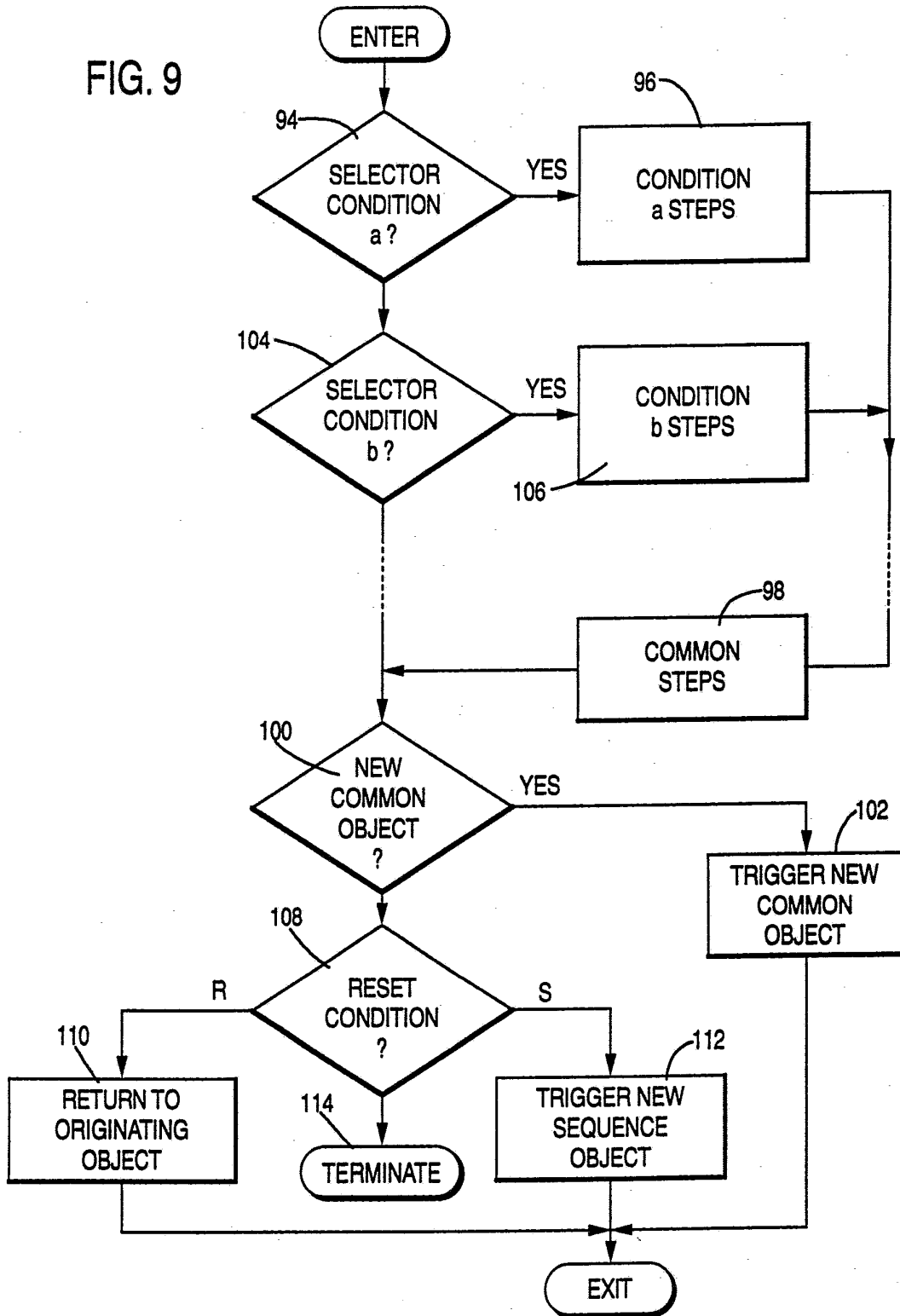
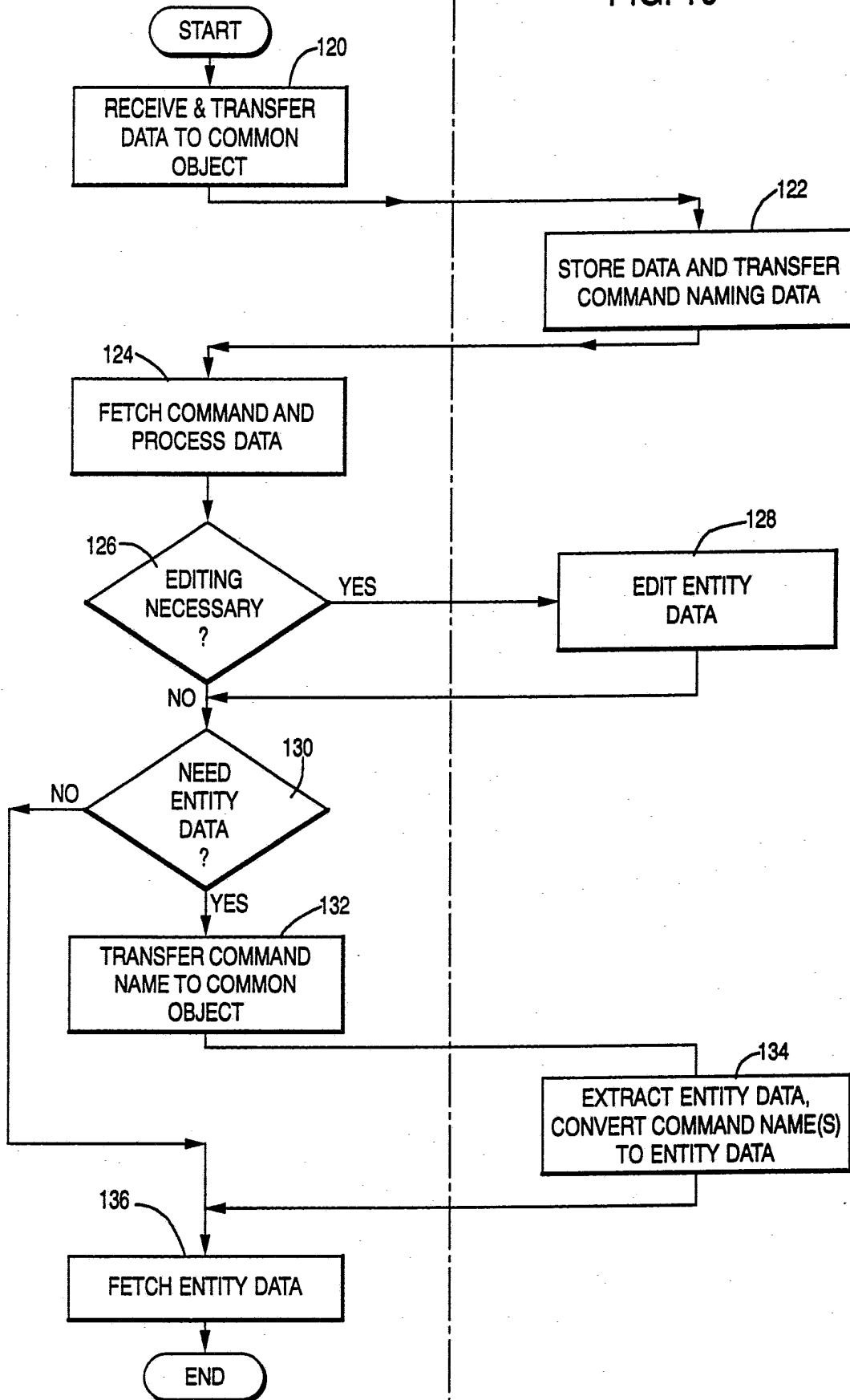
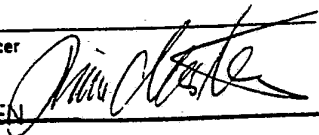


FIG. 10



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP 90/01680

| | | |
|---|--|-------------------------------------|
| I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ | | |
| According to International Patent Classification (IPC) or to both National Classification and IPC | | |
| IPC ⁵ : G 06 F 9/44, G 06 F 9/46 | | |
| II. FIELDS SEARCHED | | |
| Minimum Documentation Searched ⁷ | | |
| Classification System | Classification Symbols | |
| IPC ⁵ | G 06 F | |
| Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ | | |
| III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ | | |
| Category ⁹ | Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹² | Relevant to Claim No. ¹³ |
| Y | ACM Transactions on Computer Systems, vol. 6, no. 1, February 1988, ACM, (New York, NY, US), E. Jul et al.: "Fine-grained mobility in the Emerald System", pages 109-133, see page 111, lines 3-6; page 114, lines 1-19, section 3.2 -- | 1-5,7-8,20 |
| Y | Informationstechnik IT, vol. 30, no. 6, December 1988, R. Oldenbourg Verlag, (München, DE), G. Barth et al.: "Objektorientierte Programmierung", pages 404-421, see page 405, right-hand column, lines 10-37 -- ./. | 1-3,7-8 |
| <p>⁹ Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p> | | |
| IV. CERTIFICATION | | |
| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report | |
| 19th March 1991 | 23. 04. 91 | |
| International Searching Authority | Signature of Authorized Officer | |
| EUROPEAN PATENT OFFICE | miss T. MORTENSEN  | |

| III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET) | | |
|--|---|-----------------------|
| Category * | Citation of Document, ** with indication, where appropriate, of the relevant passages | Relevant to Claim No. |
| Y | Microprocessing and Microprogramming, vol. 24, no. 1-5, 'Supercomputers: Technology and Applications', Fourteenth EUROMICRO Symposium on Microprocessing and Microprogramming (EUROMICRO '88), Zurich, 29 August - 1 September 1988, edited by S. Winter et al., (North-Holland, Amsterdam, NL), S.T. Krolak et al.: "DEOS - A dynamically extendible object-oriented system", pages 241-248, see section 3.2 | 2-5 |
| A | -- | 23 |
| Y | Hewlett-Packard Journal, vol. 40, no. 4, August 1989, (Palo Alto, CA, US), J.A. Dysart: "The new wave object management facility", pages 17-23, see page 22, right-hand column, line 39 - page 23, left-hand column, line 3 | 4,5 |
| | ----- | |