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(54) RULE BASED ENGINE FOR VALIDATING FINANCIAL TRANSACTIONS

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(30) **Foreign Application Priority Data**

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(52) **U.S. Cl.** **718/101**

(57) **ABSTRACT**

A method and system for checking whether customer orders for transactions of financial instruments conform to business logic rules. Executable rule files are created and stored in a repository. New executable rule files can be created by scripting the new business logic rules in a script file which is converted into a corresponding source code file written in a computer programming language. The source code file is compiled to create an individual executable rule file. A rule selection repository contains identification of groups of selected executable rule files. The invention determines the category of the customer order and reads, from the rule selection repository, a group of executable rule files that correspond to the identified category of the customer order. The selected executable rule files are executed to check the conformance of the customer order. Execution results are stored in a status repository for subsequent retrieval and analysis.

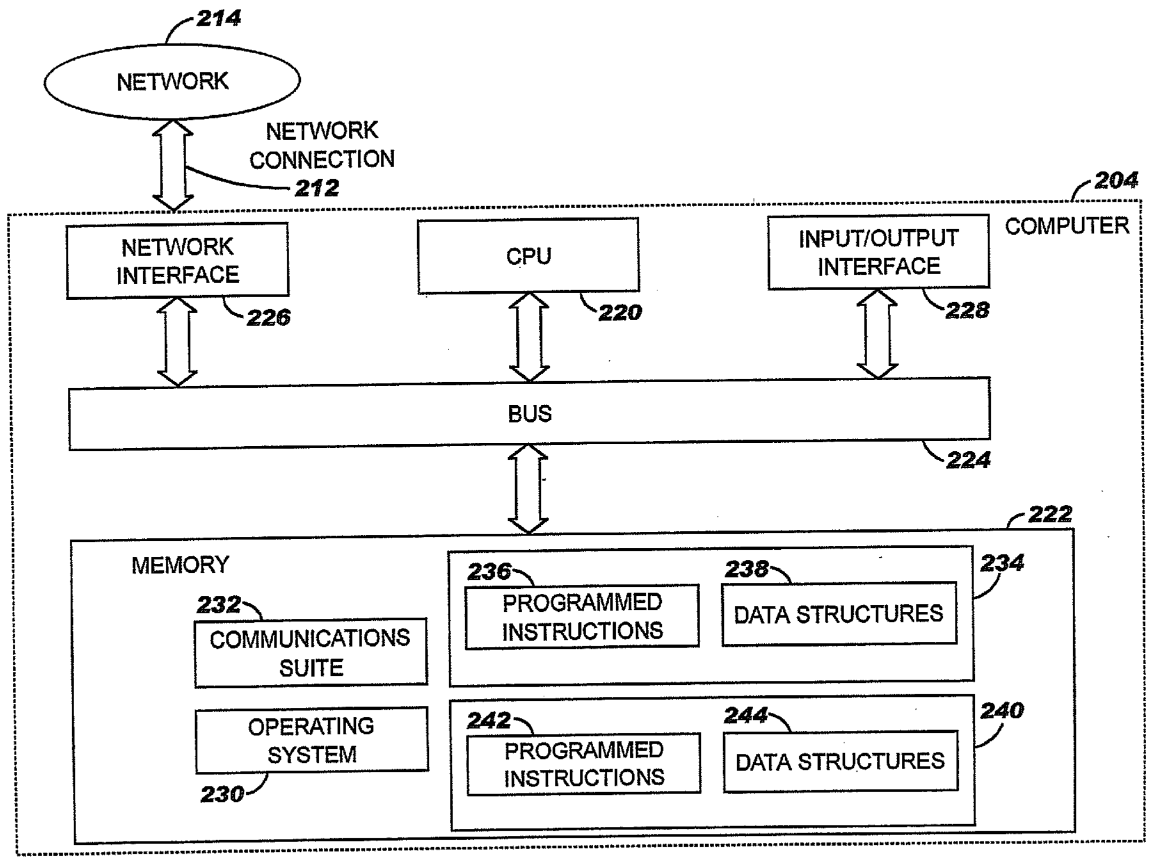


FIG. 1
(Prior Art)

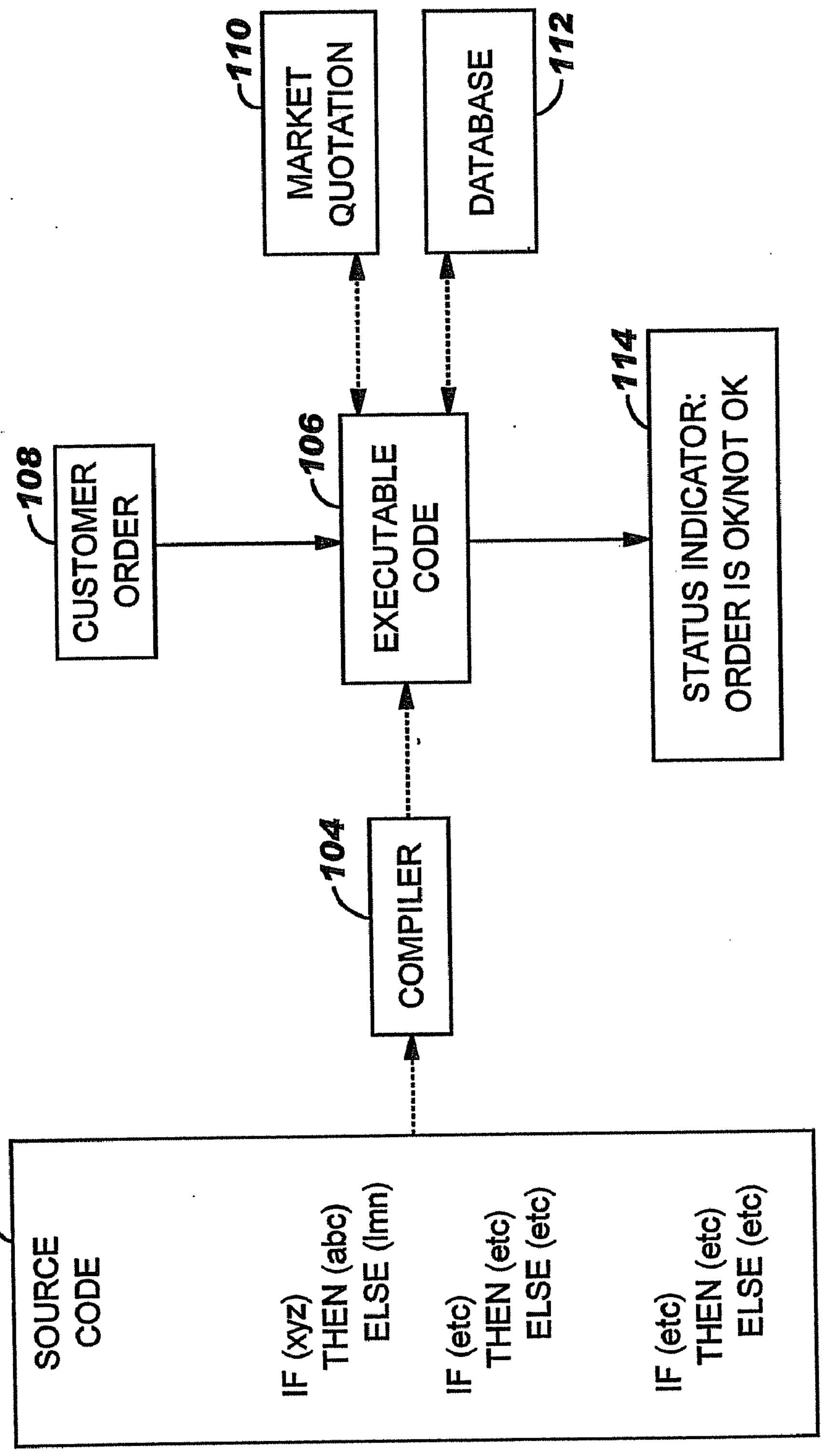


FIG. 2A

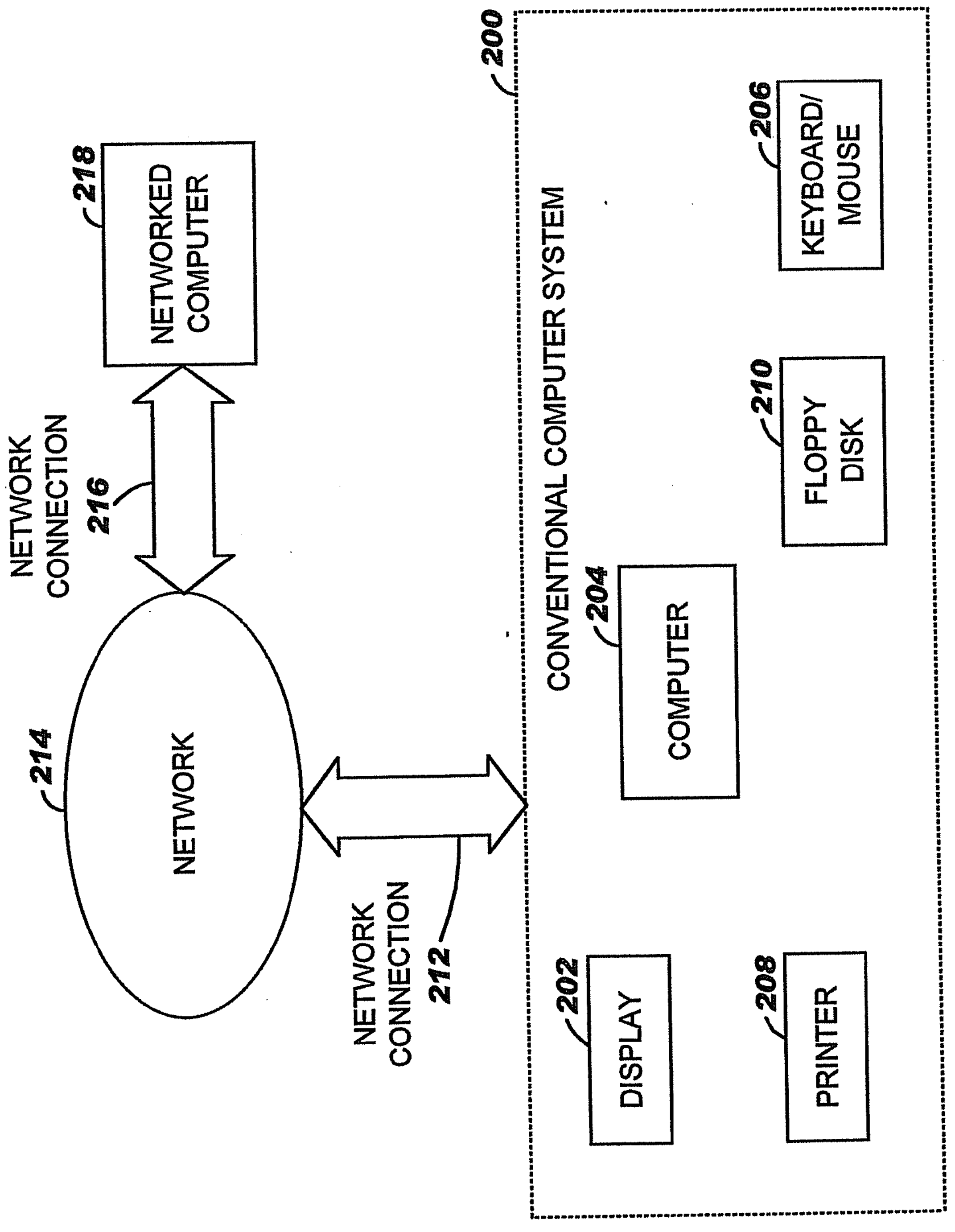

NETWORK
214
NETWORK CONNECTION
216
NETWORKED COMPUTER
218
NETWORK CONNECTION
212
200
CONVENTIONAL COMPUTER SYSTEM
DISPLAY
202
COMPUTER
204
KEYBOARD/ MOUSE
206
PRINTER
208
FLOPPY DISK
210

FIG. 2B

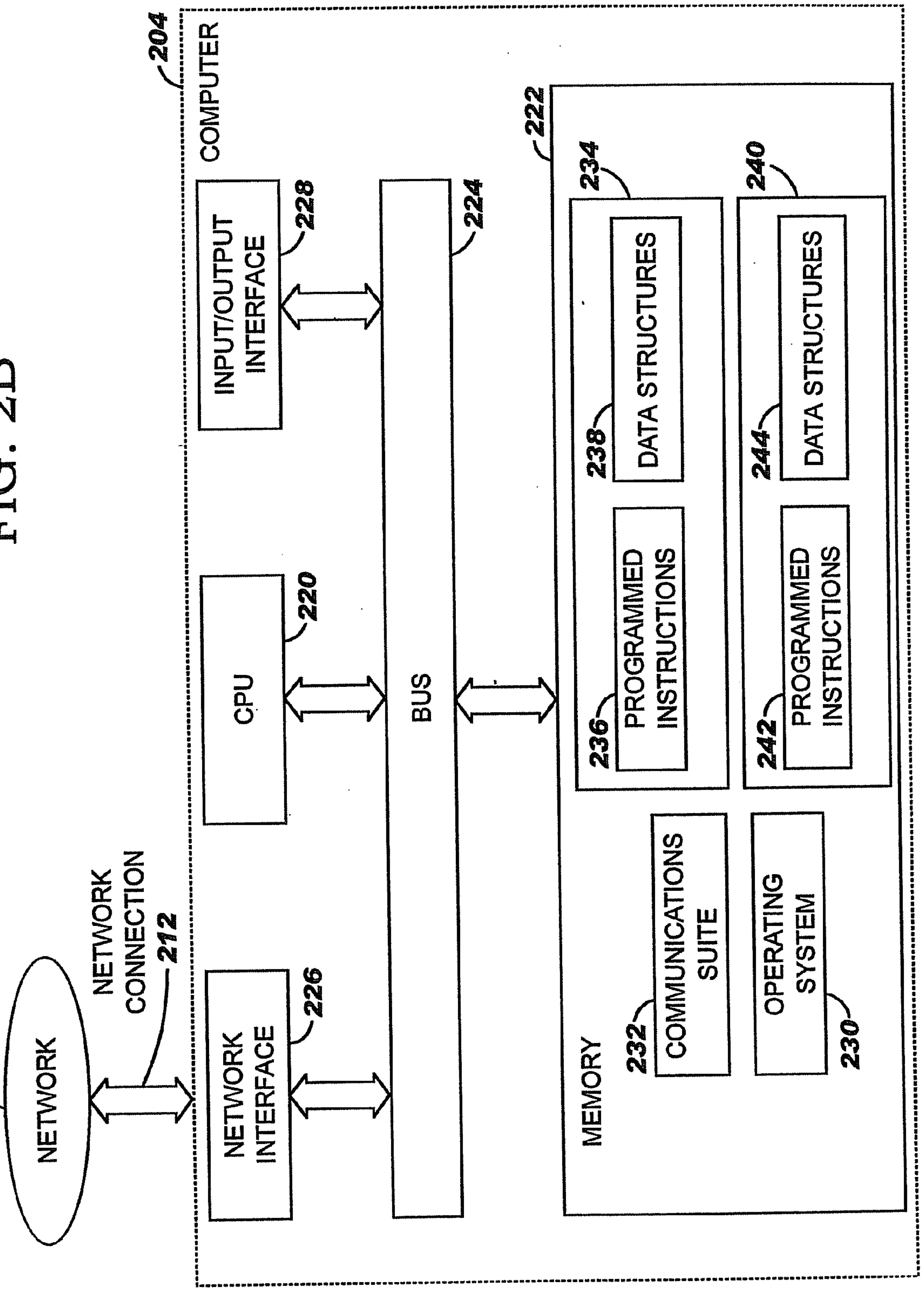
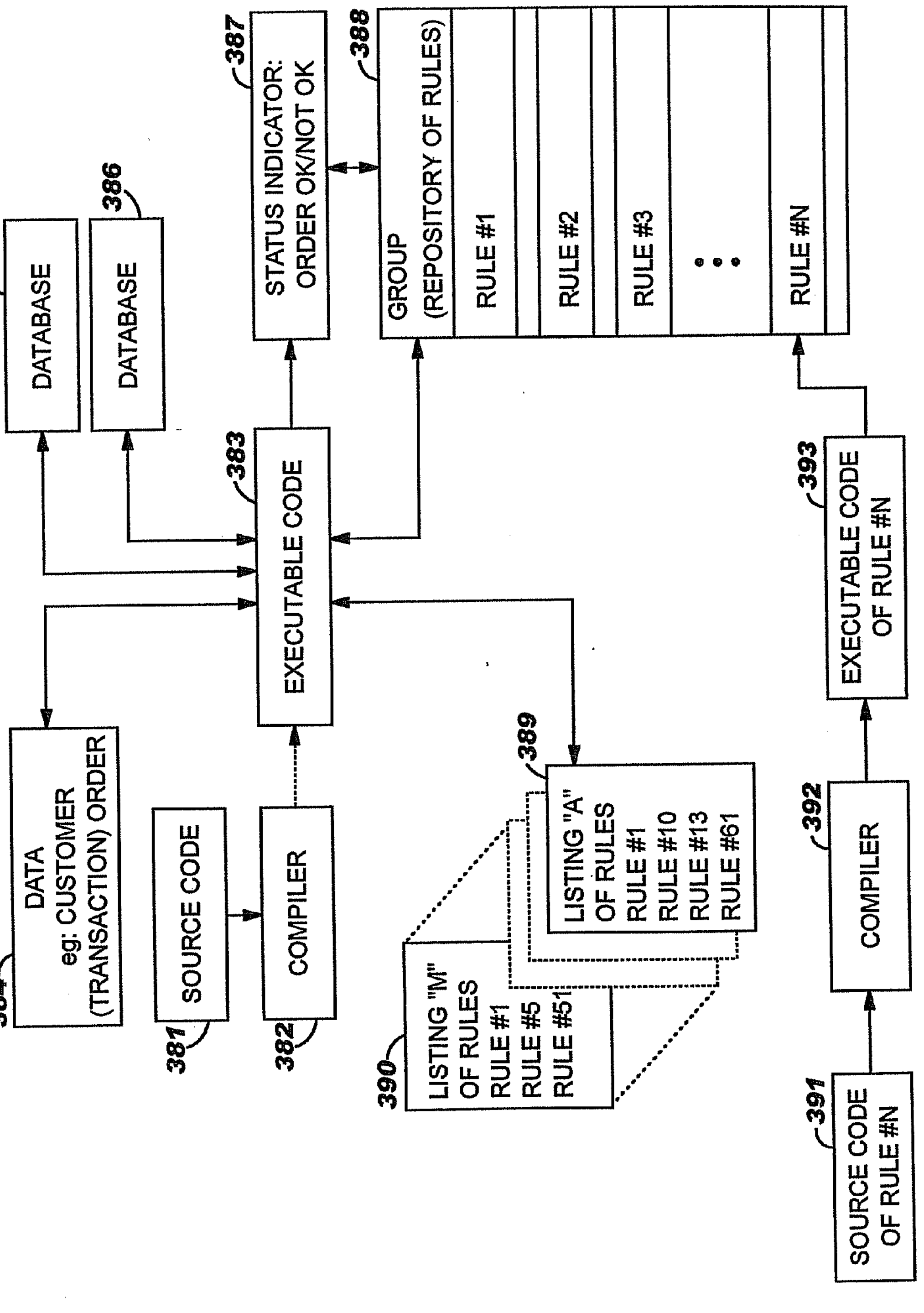
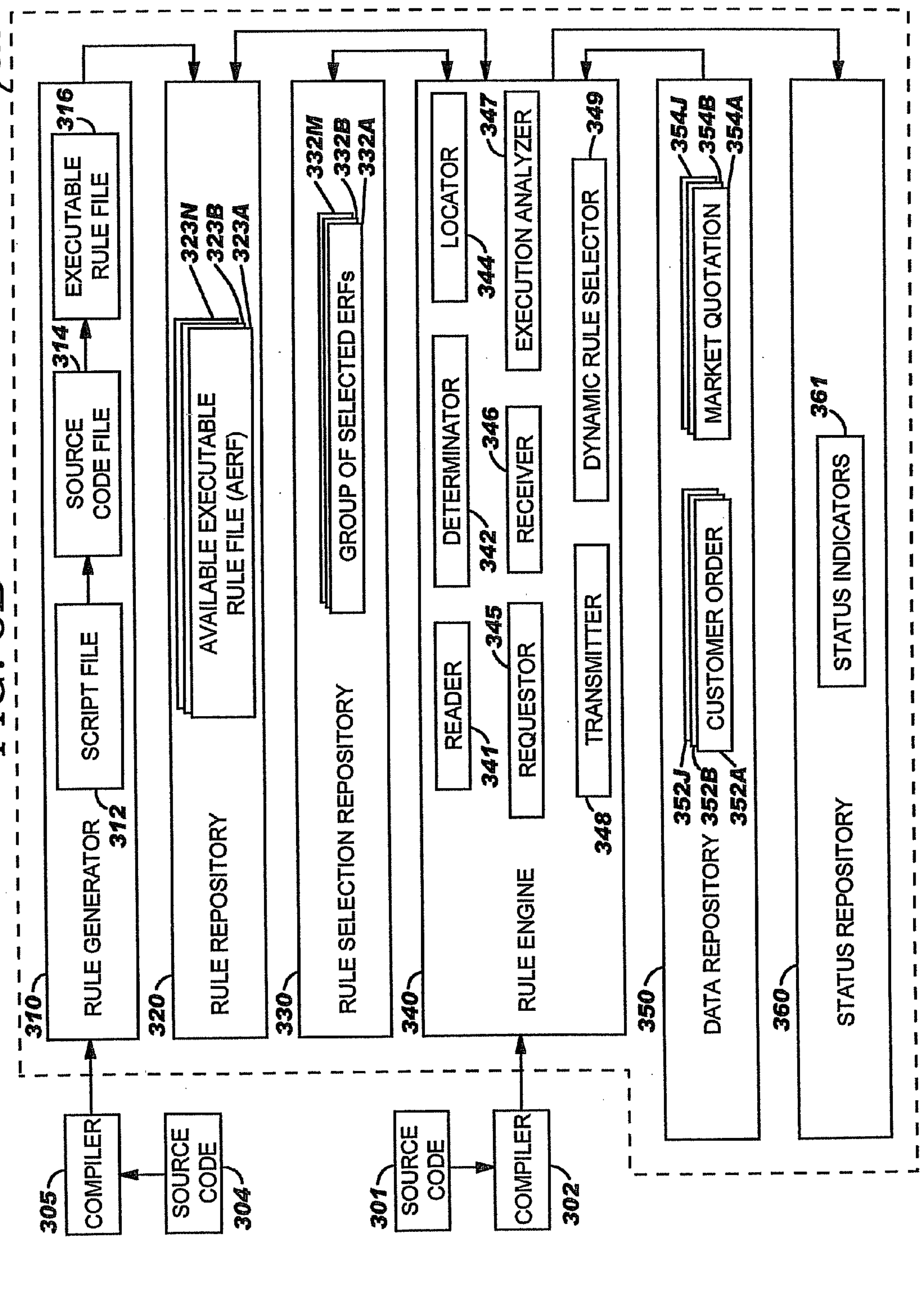

204
COMPUTER
214
NETWORK
NETWORK CONNECTION
212
NETWORK INTERFACE
226
CPU
220
INPUT/OUTPUT INTERFACE
228
BUS
224
222
MEMORY
COMMUNICATIONS SUITE
232
OPERATING SYSTEM
230
234
236
PROGRAMMED INSTRUCTIONS
238
DATA STRUCTURES
240
242
PROGRAMMED INSTRUCTIONS
244
DATA STRUCTURES

FIG. 3A



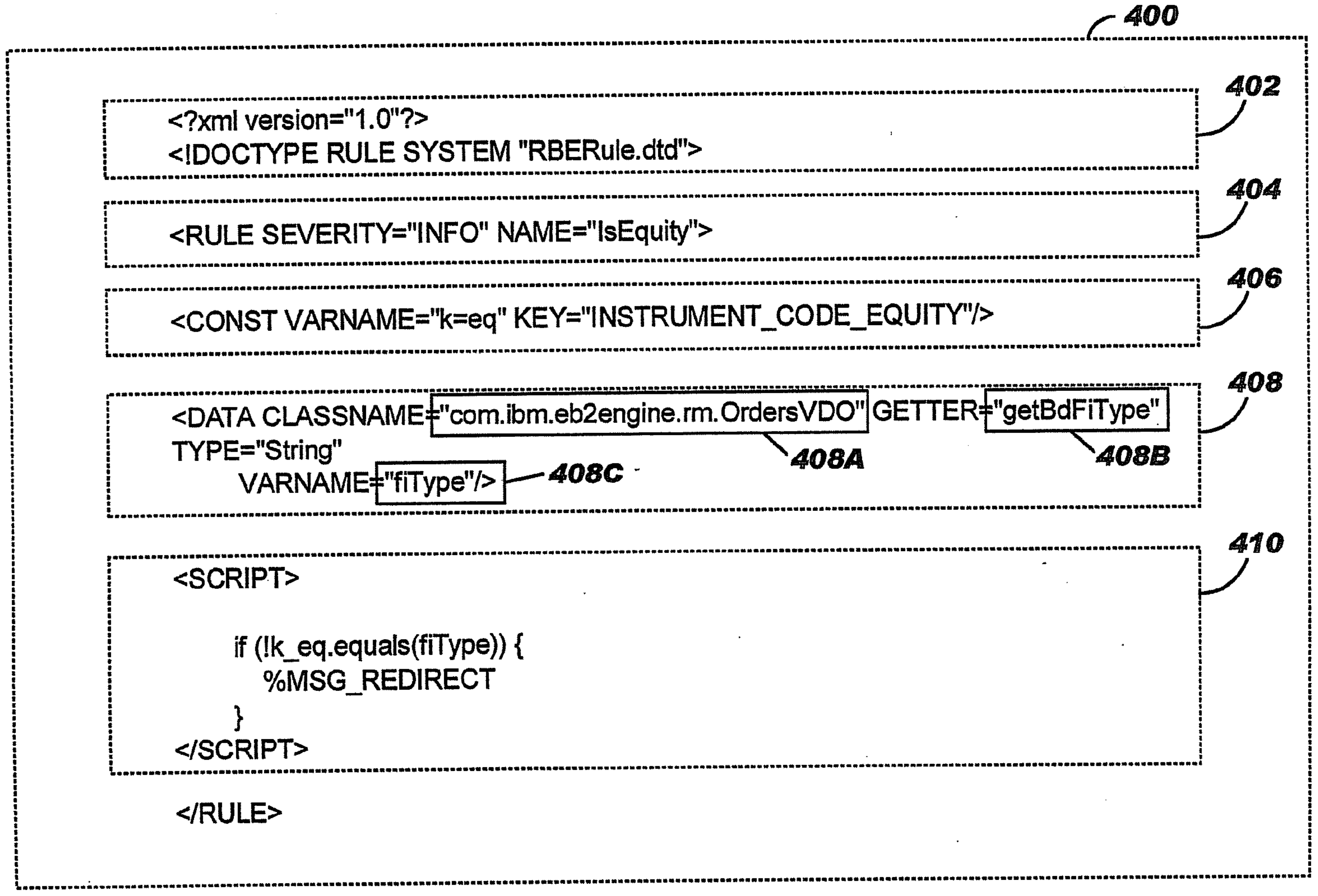
384
DATA eg: CUSTOMER (TRANSACTION) ORDER
381
SOURCE CODE
382
COMPILER
383
EXECUTABLE CODE
385
DATABASE
386
DATABASE
387
STATUS INDICATOR: ORDER OK/NOT OK
388
GROUP (REPOSITORY OF RULES)
RULE #1
RULE #2
RULE #3
• • •
RULE #N
389
LISTING "A" OF RULES
RULE #1
RULE #10
RULE #13
RULE #61
390
LISTING "M" OF RULES
RULE #1
RULE #5
RULE #51
391
SOURCE CODE OF RULE #N
392
COMPILER
393
EXECUTABLE CODE OF RULE #N

FIG. 3B



300
310
RULE GENERATOR
312
SCRIPT FILE
SOURCE CODE FILE
314
EXECUTABLE RULE FILE
316
320
RULE REPOSITORY
AVAILABLE EXECUTABLE RULE FILE (AERF)
323N
323B
323A
330
RULE SELECTION REPOSITORY
GROUP OF SELECTED ERFs
332M
332B
332A
340
RULE ENGINE
READER
341
DETERMINATOR
342
LOCATOR
344
REQUESTOR
345
RECEIVER
346
EXECUTION ANALYZER
347
TRANSMITTER
348
DYNAMIC RULE SELECTOR
349
350
DATA REPOSITORY
CUSTOMER ORDER
352J
352B
352A
MARKET QUOTATION
354J
354B
354A
360
STATUS REPOSITORY
STATUS INDICATORS
361
305
COMPILER
SOURCE CODE
304
301
SOURCE CODE
COMPILER
302

FIG. 4A



```
<?xml version="1.0"?>
<!DOCTYPE RULE SYSTEM "RBERule.dtd">

<RULE SEVERITY="INFO" NAME="IsEquity">

<CONST VARNAME="k=eq" KEY="INSTRUMENT_CODE_EQUITY"/>

<DATA CLASSNAME="com.ibm.eb2engine.rm.OrdersVDO" GETTER="getBdFiType"
TYPE="String"
      VARNAME="fiType"/>

<SCRIPT>

      if (!k_eq.equals(fiType)) {
         %MSG_REDIRECT
      }
</SCRIPT>

</RULE>
```

FIG. 4B

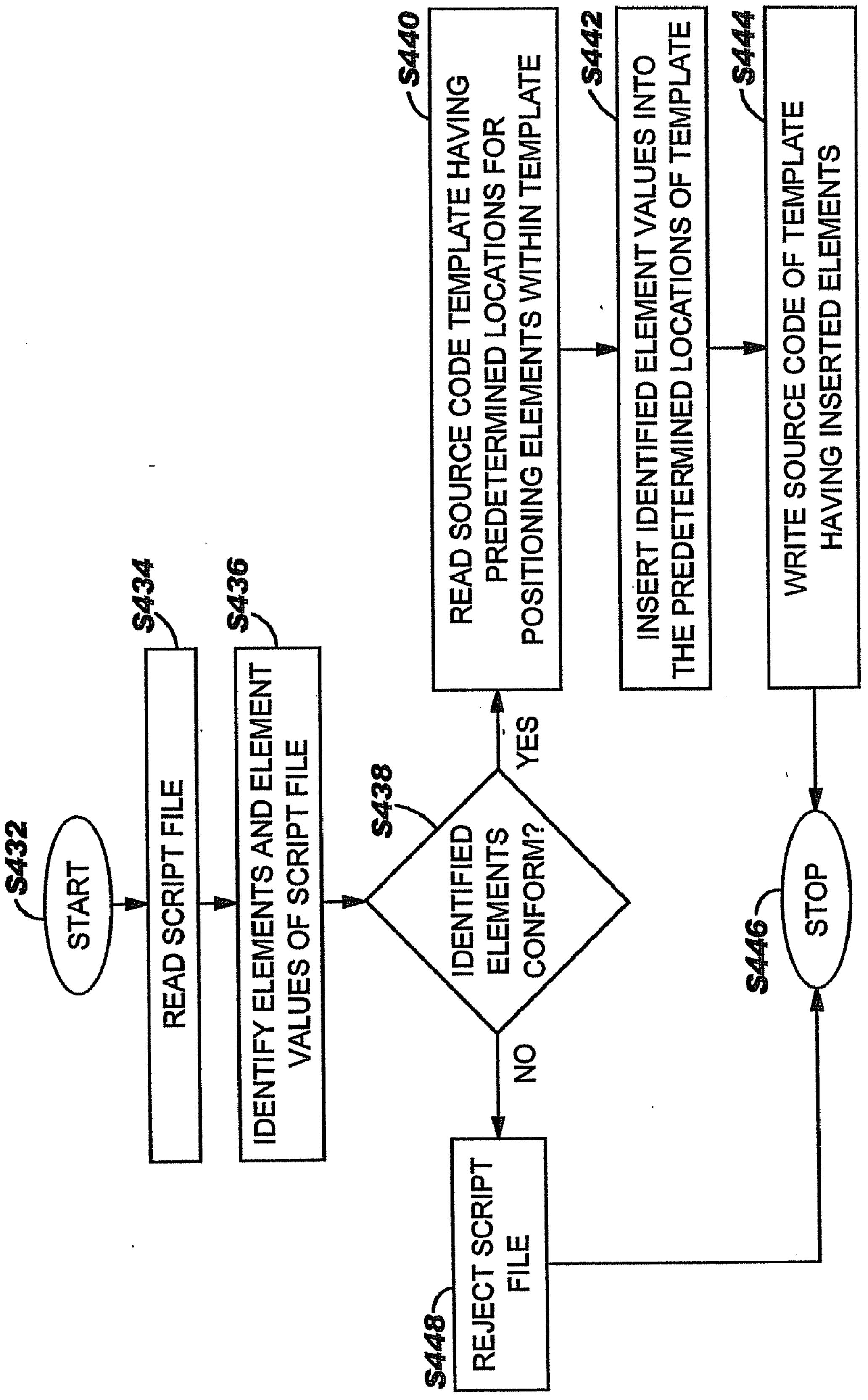
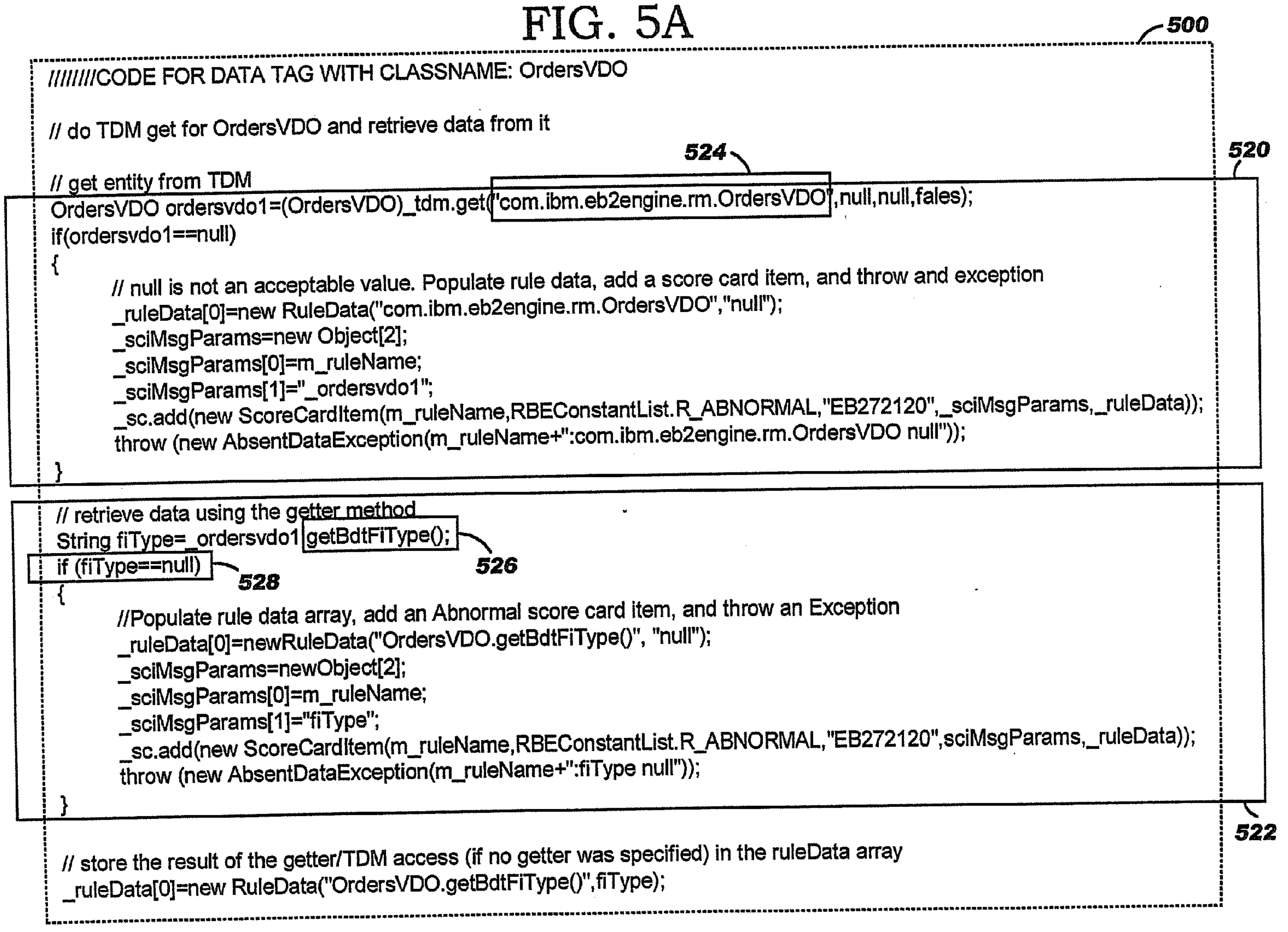

S432
START
S434
READ SCRIPT FILE
S436
IDENTIFY ELEMENTS AND ELEMENT VALUES OF SCRIPT FILE
S438
IDENTIFIED ELEMENTS CONFORM?
YES
NO
S440
READ SOURCE CODE TEMPLATE HAVING PREDETERMINED LOCATIONS FOR POSITIONING ELEMENTS WITHIN TEMPLATE
S442
INSERT IDENTIFIED ELEMENT VALUES INTO THE PREDETERMINED LOCATIONS OF TEMPLATE
S444
WRITE SOURCE CODE OF TEMPLATE HAVING INSERTED ELEMENTS
S446
STOP
S448
REJECT SCRIPT FILE

FIG. 5A



```
////////CODE FOR DATA TAG WITH CLASSNAME: OrdersVDO

// do TDM get for OrdersVDO and retrieve data from it

// get entity from TDM
OrdersVDO ordersvdo1=(OrdersVDO)_tdm.get("com.ibm.eb2engine.rm.OrdersVDO",null,null,fales);
if(ordersvdo1==null)
{
        // null is not an acceptable value. Populate rule data, add a score card item, and throw and exception
        _ruleData[0]=new RuleData("com.ibm.eb2engine.rm.OrdersVDO","null");
        _sciMsgParams=new Object[2];
        _sciMsgParams[0]=m_ruleName;
        _sciMsgParams[1]="_ordersvdo1";
        _sc.add(new ScoreCardItem(m_ruleName,RBEConstantList.R_ABNORMAL,"EB272120",_sciMsgParams,_ruleData));
        throw (new AbsentDataException(m_ruleName+":com.ibm.eb2engine.rm.OrdersVDO null"));
}
// retrieve data using the getter method
String fiType=_ordersvdo1 getBdtFiType();
if (fiType==null)
{
        //Populate rule data array, add an Abnormal score card item, and throw an Exception
        _ruleData[0]=newRuleData("OrdersVDO.getBdtFiType()", "null");
        _sciMsgParams=newObject[2];
        _sciMsgParams[0]=m_ruleName;
        _sciMsgParams[1]="fiType";
        _sc.add(new ScoreCardItem(m_ruleName,RBEConstantList.R_ABNORMAL,"EB272120",sciMsgParams,_ruleData));
        throw (new AbsentDataException(m_ruleName+":fiType null"));
}

// store the result of the getter/TDM access (if no getter was specified) in the ruleData array
_ruleData[0]=new RuleData("OrdersVDO.getBdtFiType()",fiType);
```

FIG. 5B

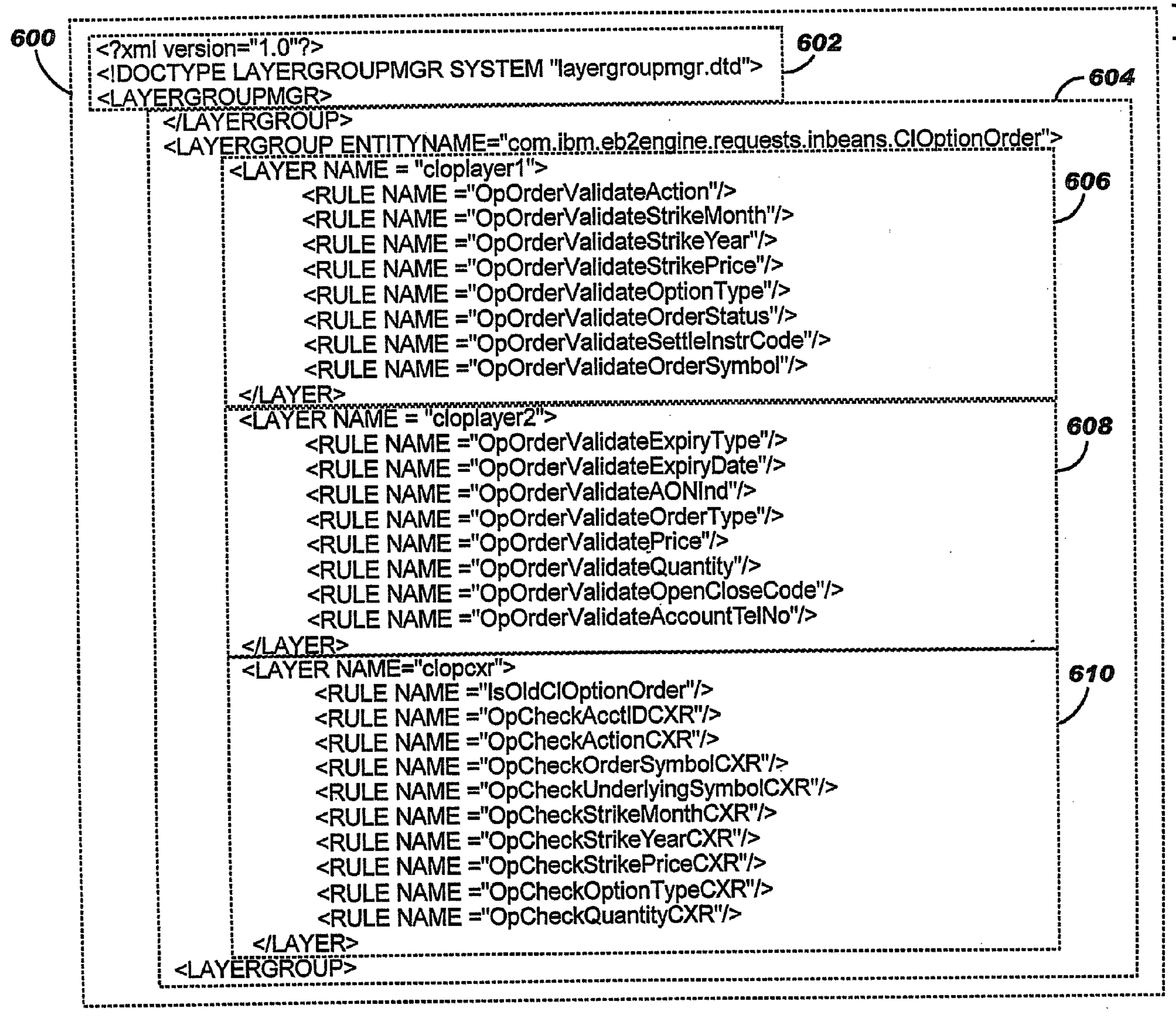
502

```
///////CODE FOR CONST TAG WITH KEY: INSTRUMENT_CODE_EQUITY

// retrieve INSTRUMENT_CODE_EQUITY from the BCM
String k_eq=(String)_bcm.get(null,"INSTRUMENT_CODE_EQUITY");

// if BCM returned null, populate rule data, and add an abnormal scorecard item, and throw an exception
if (k_eq==null)
{
        _ruleData[1]=new RuleData("INSTRUMENT_CODE_EQUITY","null");
        _sciMsgParams=new Object[2];
        _sciMsgParams[0]=m_ruleName;
        _sciMsgParams[1]="k_eq";
        _sc.add(new ScoreCardItem(m_ruleName,RBEConstantList.R_ABNORMAL,"EB272119",_sciMsgParams,_ruleData));
        throw (new AbsentBusinessConstantException(m_ruleName+":INSTRUMENT_CODE_EQUITY constant null"));
}

// add this const value to the rule data array
_ruleData[1]=new RuleData("INSTRUMENT_CODE_EQUITY",k_eq);
```

504

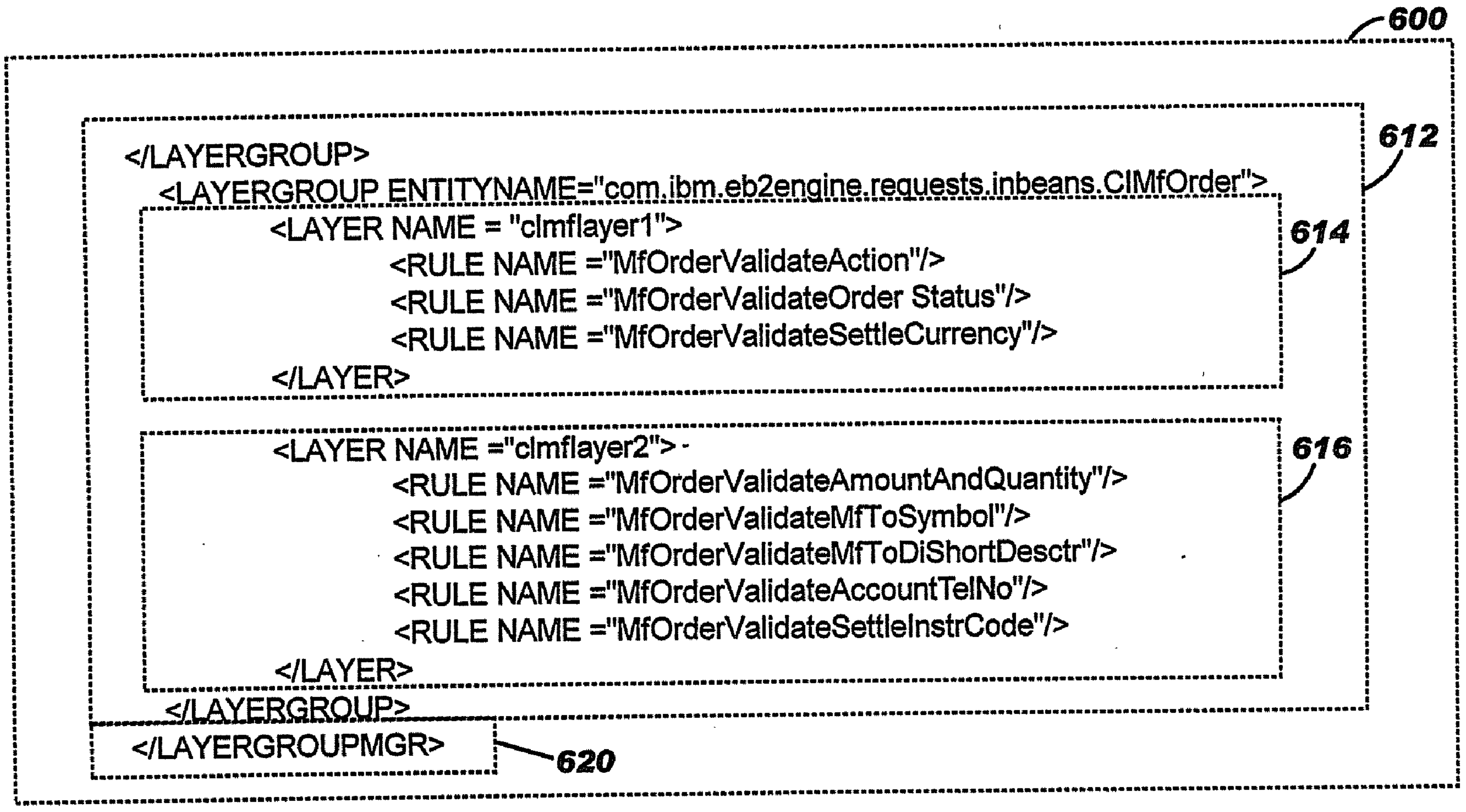
```
        //////// SCRIPT

if (k_eq.equals(fiType)) {

        // tell the scorecard that there is a redirect request
        _sc.setRedirect(true);
        return ;
```

FIG. 6A



```
<?xml version="1.0"?>
<!DOCTYPE LAYERGROUPMGR SYSTEM "layergroupmgr.dtd">
<LAYERGROUPMGR>
    </LAYERGROUP>
    <LAYERGROUP ENTITYNAME="com.ibm.eb2engine.requests.inbeans.ClOptionOrder">
        <LAYER NAME = "cloplayer1">
                <RULE NAME ="OpOrderValidateAction"/>
                <RULE NAME ="OpOrderValidateStrikeMonth"/>
                <RULE NAME ="OpOrderValidateStrikeYear"/>
                <RULE NAME ="OpOrderValidateStrikePrice"/>
                <RULE NAME ="OpOrderValidateOptionType"/>
                <RULE NAME ="OpOrderValidateOrderStatus"/>
                <RULE NAME ="OpOrderValidateSettleInstrCode"/>
                <RULE NAME ="OpOrderValidateOrderSymbol"/>
        </LAYER>
        <LAYER NAME = "cloplayer2">
                <RULE NAME ="OpOrderValidateExpiryType"/>
                <RULE NAME ="OpOrderValidateExpiryDate"/>
                <RULE NAME ="OpOrderValidateAONInd"/>
                <RULE NAME ="OpOrderValidateOrderType"/>
                <RULE NAME ="OpOrderValidatePrice"/>
                <RULE NAME ="OpOrderValidateQuantity"/>
                <RULE NAME ="OpOrderValidateOpenCloseCode"/>
                <RULE NAME ="OpOrderValidateAccountTelNo"/>
        </LAYER>
        <LAYER NAME="clopcxr">
                <RULE NAME ="IsOldClOptionOrder"/>
                <RULE NAME ="OpCheckAcctIDCXR"/>
                <RULE NAME ="OpCheckActionCXR"/>
                <RULE NAME ="OpCheckOrderSymbolCXR"/>
                <RULE NAME ="OpCheckUnderlyingSymbolCXR"/>
                <RULE NAME ="OpCheckStrikeMonthCXR"/>
                <RULE NAME ="OpCheckStrikeYearCXR"/>
                <RULE NAME ="OpCheckStrikePriceCXR"/>
                <RULE NAME ="OpCheckOptionTypeCXR"/>
                <RULE NAME ="OpCheckQuantityCXR"/>
        </LAYER>
    <LAYERGROUP>
```

FIG. 6B



```
</LAYERGROUP>
  <LAYERGROUP ENTITYNAME="com.ibm.eb2engine.requests.inbeans.CIMfOrder">
         <LAYER NAME = "clmflayer1">
                <RULE NAME ="MfOrderValidateAction"/>
                <RULE NAME ="MfOrderValidateOrder Status"/>
                <RULE NAME ="MfOrderValidateSettleCurrency"/>
         </LAYER>

         <LAYER NAME ="clmflayer2"> -
                <RULE NAME ="MfOrderValidateAmountAndQuantity"/>
                <RULE NAME ="MfOrderValidateMfToSymbol"/>
                <RULE NAME ="MfOrderValidateMfToDiShortDesctr"/>
                <RULE NAME ="MfOrderValidateAccountTelNo"/>
                <RULE NAME ="MfOrderValidateSettleInstrCode"/>
         </LAYER>
  </LAYERGROUP>
</LAYERGROUPMGR>
```

FIG. 7

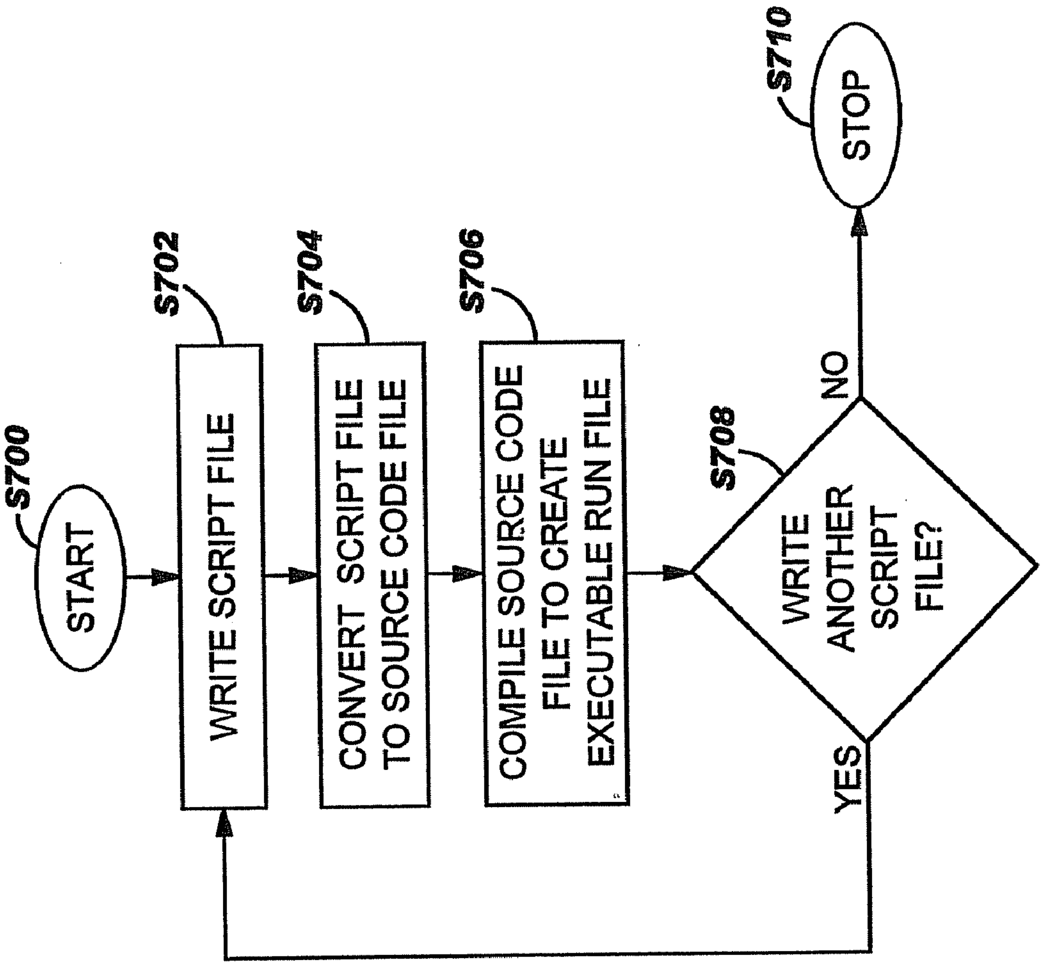

S700
START
S702
WRITE SCRIPT FILE
S704
CONVERT SCRIPT FILE TO SOURCE CODE FILE
S706
COMPILE SOURCE CODE FILE TO CREATE EXECUTABLE RUN FILE
S708
WRITE ANOTHER SCRIPT FILE?
YES
NO
S710
STOP

FIG. 8

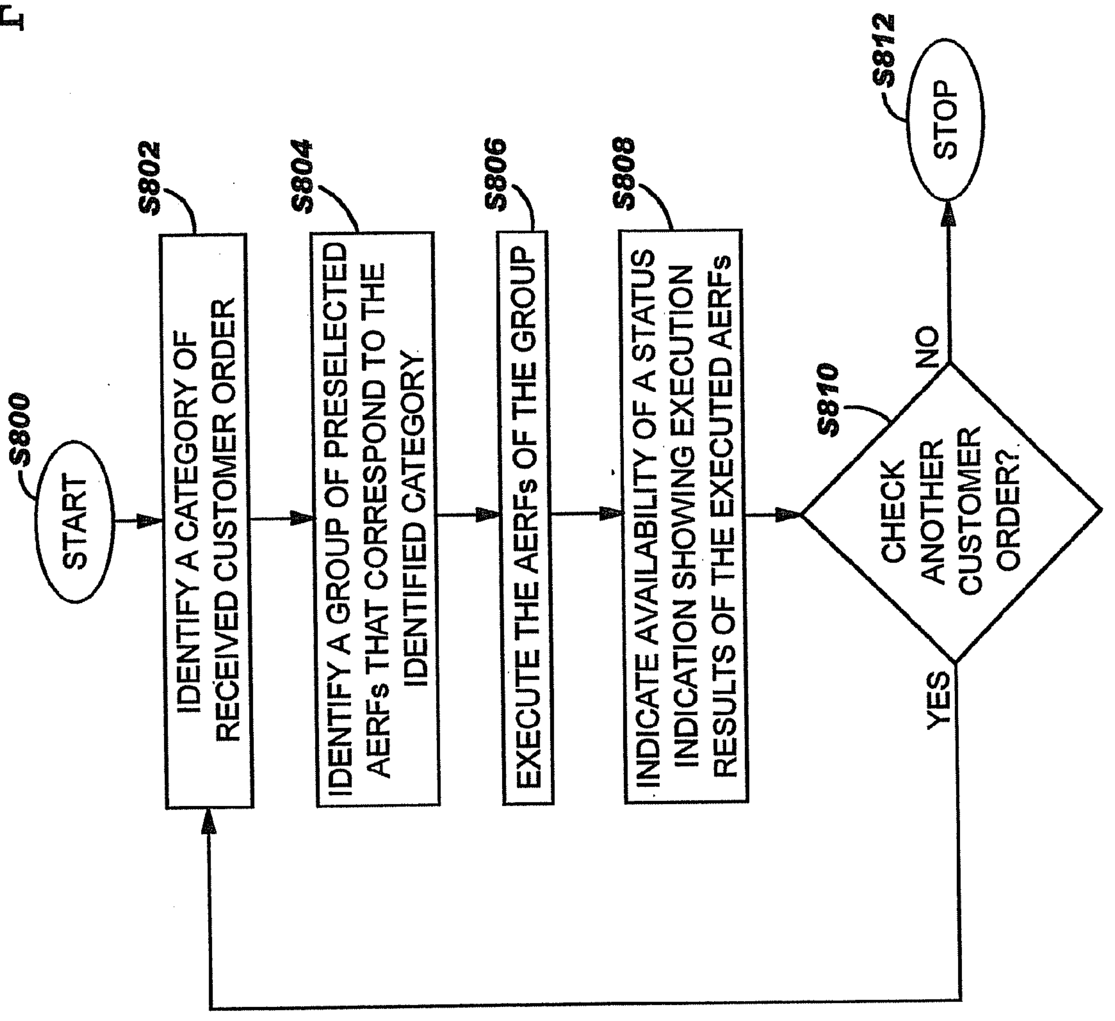

S800
START
S802
IDENTIFY A CATEGORY OF RECEIVED CUSTOMER ORDER
S804
IDENTIFY A GROUP OF PRESELECTED AERFs THAT CORRESPOND TO THE IDENTIFIED CATEGORY
S806
EXECUTE THE AERFs OF THE GROUP
S808
INDICATE AVAILABILITY OF A STATUS INDICATION SHOWING EXECUTION RESULTS OF THE EXECUTED AERFs
S810
CHECK ANOTHER CUSTOMER ORDER?
YES
NO
S812
STOP

FIG. 9

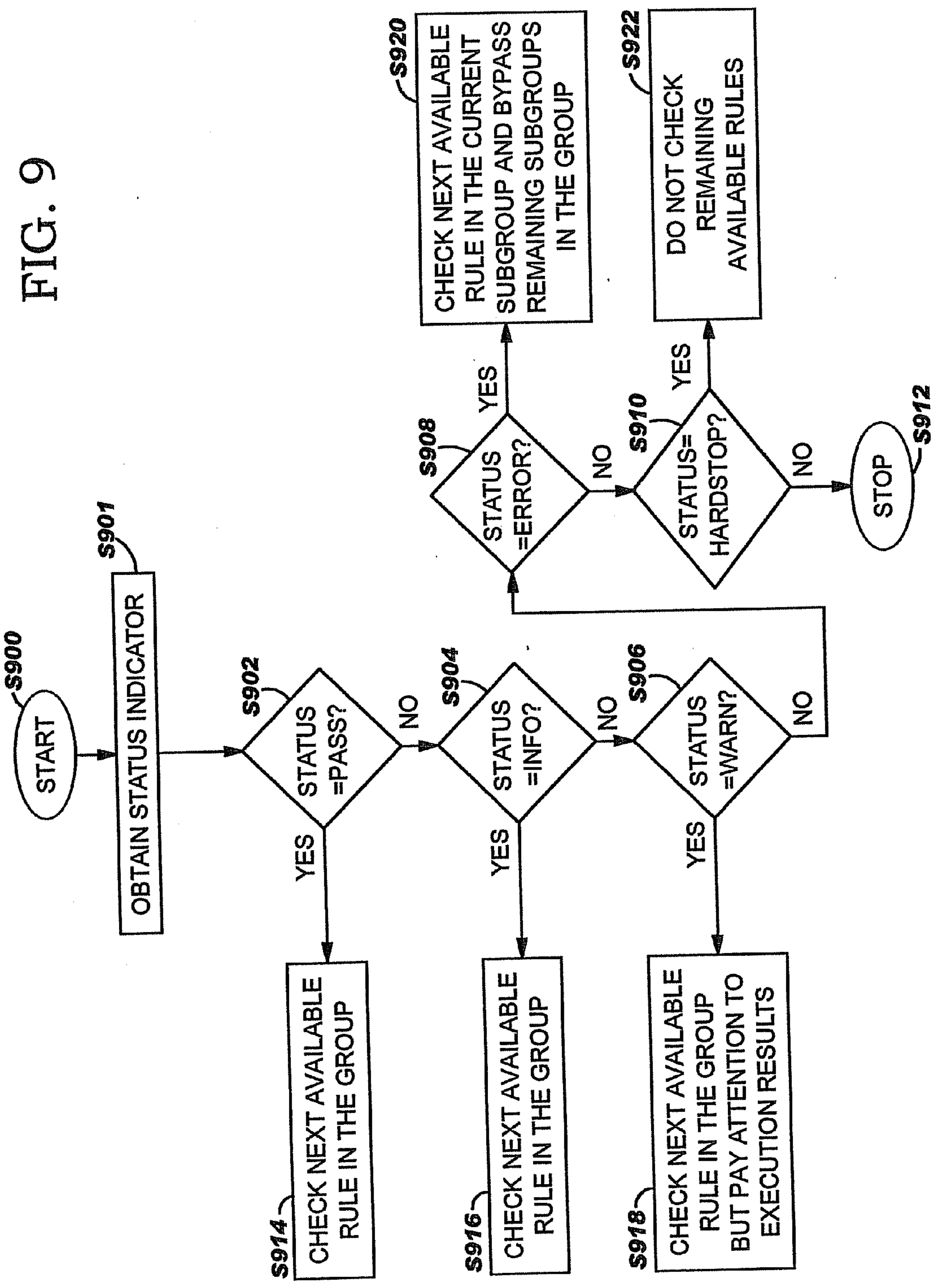
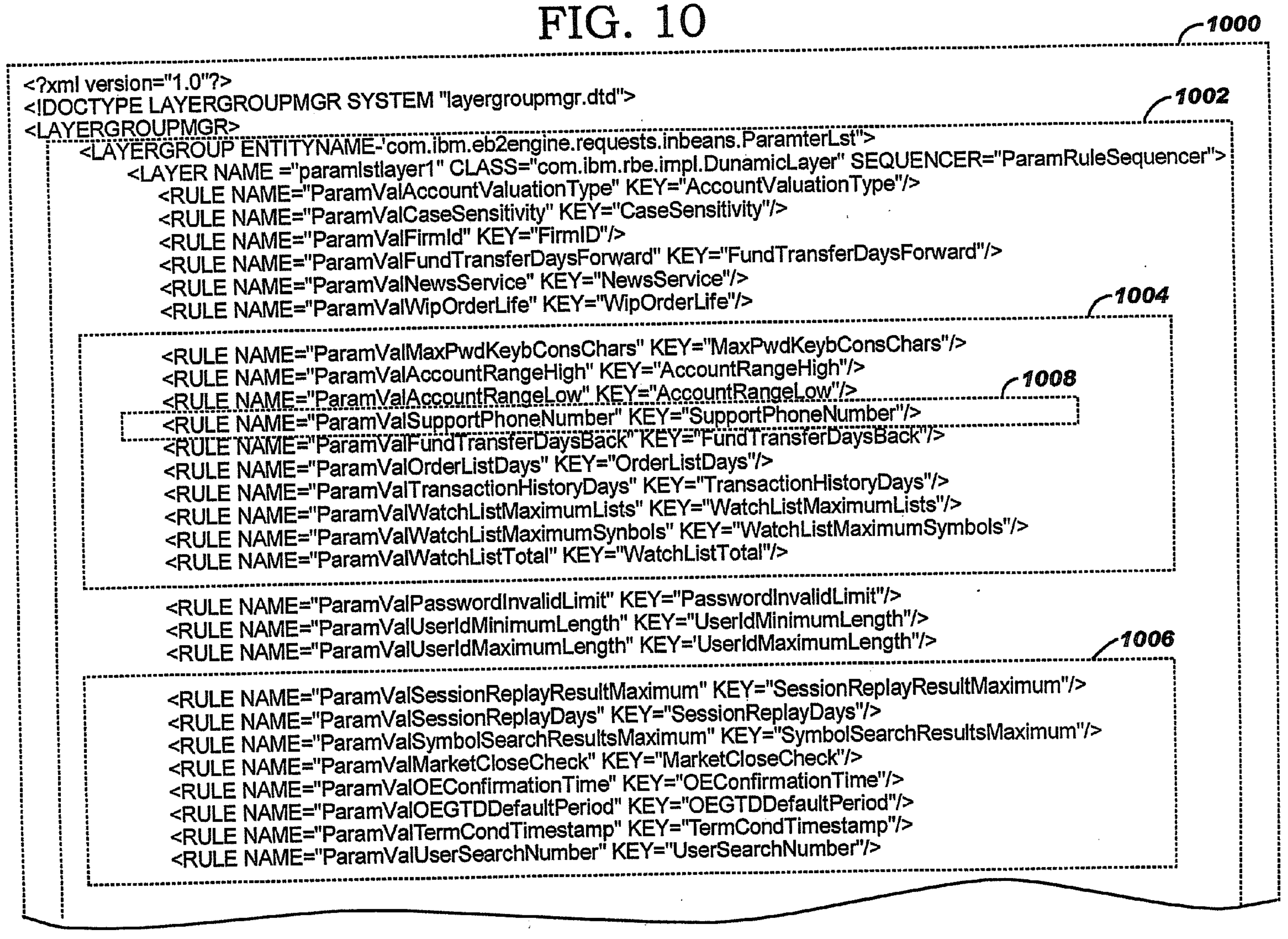
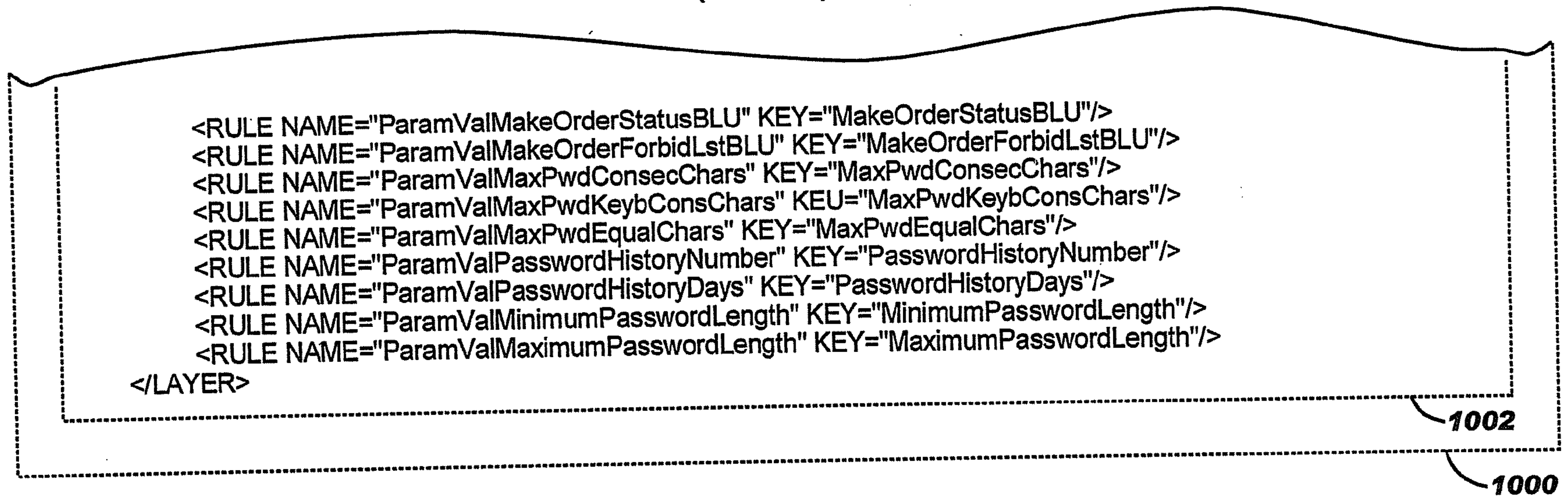

S900
START
S901
OBTAIN STATUS INDICATOR
S902
STATUS =PASS?
YES
NO
S914
CHECK NEXT AVAILABLE RULE IN THE GROUP
S904
STATUS =INFO?
YES
NO
S916
CHECK NEXT AVAILABLE RULE IN THE GROUP
S906
STATUS =WARN?
YES
NO
S918
CHECK NEXT AVAILABLE RULE IN THE GROUP BUT PAY ATTENTION TO EXECUTION RESULTS
S908
STATUS =ERROR?
YES
NO
S920
CHECK NEXT AVAILABLE RULE IN THE CURRENT SUBGROUP AND BYPASS REMAINING SUBGROUPS IN THE GROUP
S910
STATUS= HARDSTOP?
YES
NO
S922
DO NOT CHECK REMAINING AVAILABLE RULES
S912
STOP

FIG. 10



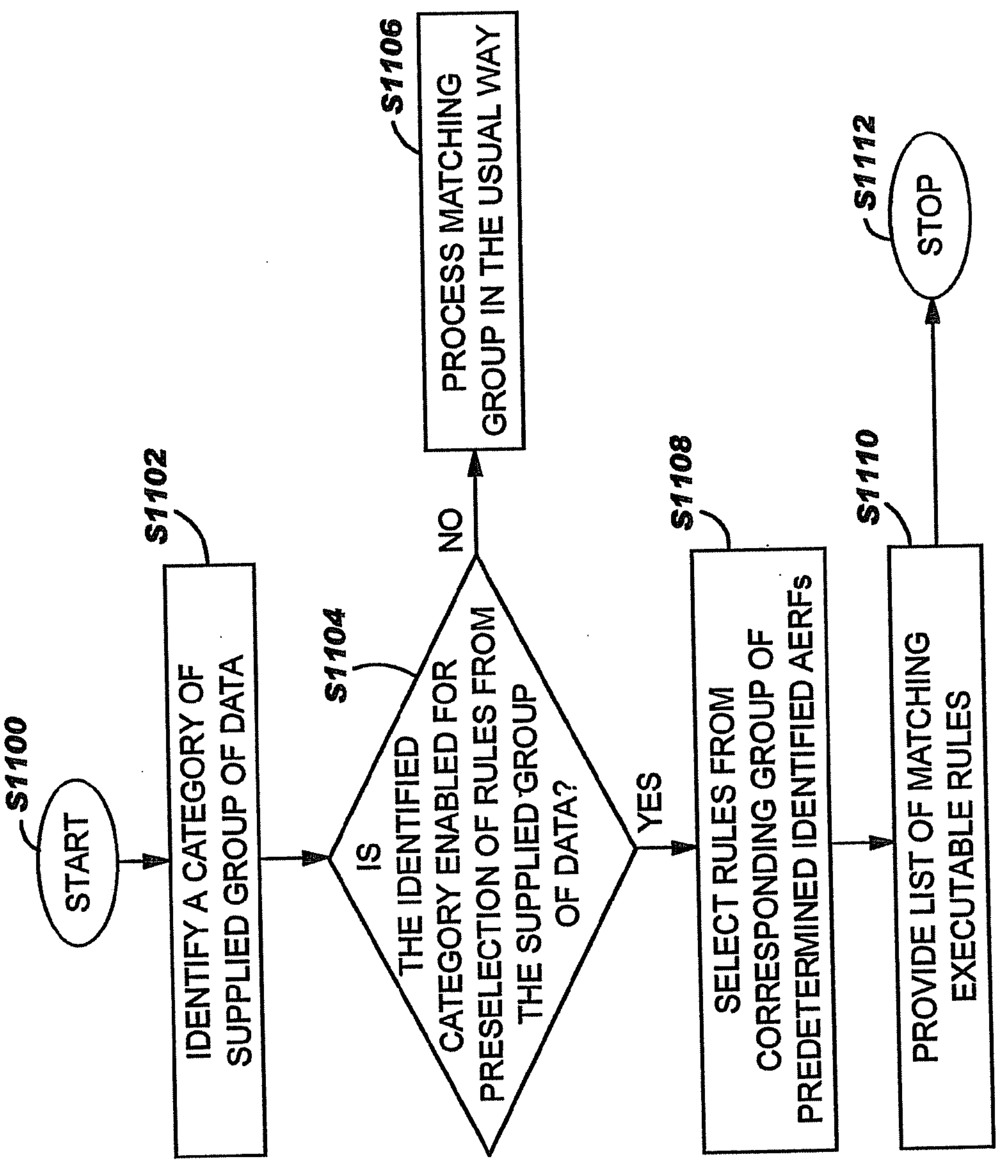
```
<?xml version="1.0"?>
<!DOCTYPE LAYERGROUPMGR SYSTEM "layergroupmgr.dtd">
<LAYERGROUPMGR>
   <LAYERGROUP ENTITYNAME-'com.ibm.eb2engine.requests.inbeans.ParamterLst">
      <LAYER NAME ="paramlstlayer1" CLASS="com.ibm.rbe.impl.DunamicLayer" SEQUENCER="ParamRuleSequencer">
         <RULE NAME="ParamValAccountValuationType" KEY="AccountValuationType"/>
         <RULE NAME="ParamValCaseSensitivity" KEY="CaseSensitivity"/>
         <RULE NAME="ParamValFirmId" KEY="FirmID"/>
         <RULE NAME="ParamValFundTransferDaysForward" KEY="FundTransferDaysForward"/>
         <RULE NAME="ParamValNewsService" KEY="NewsService"/>
         <RULE NAME="ParamValWipOrderLife" KEY="WipOrderLife"/>

         <RULE NAME="ParamValMaxPwdKeybConsChars" KEY="MaxPwdKeybConsChars"/>
         <RULE NAME="ParamValAccountRangeHigh" KEY="AccountRangeHigh"/>
         <RULE NAME="ParamValAccountRangeLow" KEY="AccountRangeLow"/>
         <RULE NAME="ParamValSupportPhoneNumber" KEY="SupportPhoneNumber"/>
         <RULE NAME="ParamValFundTransferDaysBack" KEY="FundTransferDaysBack"/>
         <RULE NAME="ParamValOrderListDays" KEY="OrderListDays"/>
         <RULE NAME="ParamValTransactionHistoryDays" KEY="TransactionHistoryDays"/>
         <RULE NAME="ParamValWatchListMaximumLists" KEY="WatchListMaximumLists"/>
         <RULE NAME="ParamValWatchListMaximumSynbols" KEY="WatchListMaximumSymbols"/>
         <RULE NAME="ParamValWatchListTotal" KEY="WatchListTotal"/>

         <RULE NAME="ParamValPasswordInvalidLimit" KEY="PasswordInvalidLimit"/>
         <RULE NAME="ParamValUserIdMinimumLength" KEY="UserIdMinimumLength"/>
         <RULE NAME="ParamValUserIdMaximumLength" KEY='UserIdMaximumLength"/>

         <RULE NAME="ParamValSessionReplayResultMaximum" KEY="SessionReplayResultMaximum"/>
         <RULE NAME="ParamValSessionReplayDays" KEY="SessionReplayDays"/>
         <RULE NAME="ParamValSymbolSearchResultsMaximum" KEY="SymbolSearchResultsMaximum"/>
         <RULE NAME="ParamValMarketCloseCheck" KEY="MarketCloseCheck"/>
         <RULE NAME="ParamValOEConfirmationTime" KEY="OEConfirmationTime"/>
         <RULE NAME="ParamValOEGTDDefaultPeriod" KEY="OEGTDDefaultPeriod"/>
         <RULE NAME="ParamValTermCondTimestamp" KEY="TermCondTimestamp"/>
         <RULE NAME="ParamValUserSearchNumber" KEY="UserSearchNumber"/>
```

FIG. 10
(cont'd)



```
        <RULE NAME="ParamValMakeOrderStatusBLU" KEY="MakeOrderStatusBLU"/>
        <RULE NAME="ParamValMakeOrderForbidLstBLU" KEY="MakeOrderForbidLstBLU"/>
        <RULE NAME="ParamValMaxPwdConsecChars" KEY="MaxPwdConsecChars"/>
        <RULE NAME="ParamValMaxPwdKeybConsChars" KEU="MaxPwdKeybConsChars"/>
        <RULE NAME="ParamValMaxPwdEqualChars" KEY="MaxPwdEqualChars"/>
        <RULE NAME="ParamValPasswordHistoryNumber" KEY="PasswordHistoryNumber"/>
        <RULE NAME="ParamValPasswordHistoryDays" KEY="PasswordHistoryDays"/>
        <RULE NAME="ParamValMinimumPasswordLength" KEY="MinimumPasswordLength"/>
        <RULE NAME="ParamValMaximumPasswordLength" KEY="MaximumPasswordLength"/>
    </LAYER>
```

FIG. 11


S1100
START
S1102
IDENTIFY A CATEGORY OF SUPPLIED GROUP OF DATA
S1104
IS THE IDENTIFIED CATEGORY ENABLED FOR PRESELECTION OF RULES FROM THE SUPPLIED GROUP OF DATA?
NO
S1106
PROCESS MATCHING GROUP IN THE USUAL WAY
YES
S1108
SELECT RULES FROM CORRESPONDING GROUP OF PREDETERMINED IDENTIFIED AERFs
S1110
PROVIDE LIST OF MATCHING EXECUTABLE RULES
S1112
STOP

RULE BASED ENGINE FOR VALIDATING FINANCIAL TRANSACTIONS

[0001] This application is a continuation application claiming priority to Ser. No. 10/178,439, filed Jun. 24, 2002.

FIELD OF THE INVENTION

[0002] The present invention relates to a system and method for checking conformance of input data prior to subsequent processing, and more specifically to a system and a method for checking whether financial transactions conform to corresponding sets of selected executable rule files containing business logic rules.

BACKGROUND OF THE INVENTION

[0003] The brokerage industry can be highly competitive. Strategically, brokerage firms often attempt to gain a larger market share of customers by offering lower transactions fees. It is highly desirable for brokers to continually find ways to reduce their operating costs associated with fulfilling or transacting customer orders for financial instruments, such as stocks, bonds, options, and mutual funds, while maintaining or improving their ability to serve customers by reliably fulfilling customer orders on a timely basis.

[0004] Typically, brokerages accept or input customer orders via their systems and then forward the orders to an existing order fulfilment system or legacy system for subsequent transaction of the customer order. Typically, the order fulfilment system is a legacy system that has been reliably operating for many years, and legacy systems are rarely modified to perform significantly new functions to avoid potentially undesirable consequences to the overall system performance. However, when a customer order for a financial transaction has flaws, the existing order fulfilment system cannot fulfil the customer order and the subsequently unfulfilled customer order is returned by the existing order fulfilment system to the broker along with a financial charge for incurred processing time on the existing order fulfilment system. In such a situation, the customer order may not be fulfilled on a timely basis and undesirable costs may be incurred in the attempt to transact the customer order.

[0005] Typically, a programming application, written in a computer programming language, includes nested programming logic having if/then programming statements each implementing business logic rules for a specific broker. The programming application is subsequently compiled into an executable file which is then used by a central processing unit to check the conformance of customer orders. Typically, the implemented business logic rules are relevant for the business needs of a specific broker. Frequently, the programming application requires modifications to the implemented business logic rules, in which case, the entire program needs to be reviewed by an expert computer programmer and recompiled and re-tested to ensure suitable and reliable operation. However, the prior art applications are frequently difficult to maintain typically because expert computer programmers do not remain with the same employer, or documentation of the programming is severely lacking in depth. Therefore, new programmers face the task of learning a new programming language to remove, add, modify business logic rules and re-test the updated computer application. Additionally, the known prior art computer applications require that all of the rules need to be serially or sequentially applied in an inflexible manner to each customer order. This inflexibility leads to an accumulation of unnecessary processing time and effort on the behalf of a computer system because not all of the rules may be required to check whether data elements of each customer order conform to the business logic rules.

[0006] Another problem experienced with on-line transaction of customer orders is that even though the customer orders may appear to be acceptable to a existing order fulfilment system, the customer order may not be appropriate with respect to an investment profile or preferences of the customer. This can lead to brokers transacting inappropriate types of customer orders for some customers. Some jurisdictions require brokers to know the investment tolerances or profiles of their clients before transacting customer orders, which is known as 'know your customer' rules.

[0007] In conclusion, prior art systems codify the business logic rules into a single source code file and subsequently compile the source code file to create a single executable file. However, when the business logic rules require to be changed, a computer programmer is required to examine the original source code, ascertain the extent of the required changes, test, and debug the new code, followed by the required compilation to create an updated or revised executable file. Disadvantageously, this required the talents of an experienced programmer, and if that programmer were new to the organization, then more time would be required to understand the original source code especially if the original source code were not properly documented. Also, even an experienced programmer would not typically appreciate or understand the requirements of a business and the types of business logic rules that would be required to check conformance of customer orders. Disadvantageously, the business logic would change periodically to suit the needs of regulatory agencies or stock market conditions, which would place a undue burden on the programmer attempting to adapt the source code to newly developed business logic rules.

SUMMARY OF THE INVENTION

[0008] The present invention provides a system for checking whether input data, such as customer orders for transactions of financial instruments, conform to business logic rules. The system enables a non-programmer to include, remove, and/or reorder, in a simple text file, a set of individually identified executable rule files each encoding business logic rules, thereby significantly reducing the need to recompile the entire program application. Each executable rule file is individually created and stored in a repository of available executable rule files (AERFs). When an executable rule becomes obsolete, a new executable rule file can be created by scripting the new business logic rules in a script file which in turn is converted into a corresponding source code file being written in a convenient computer programming language. Subsequently, the source code file is compiled to create an individual executable rule file, which is then placed into the rule repository. A rule selection repository, which can be implemented as a structured text file, is used for containing identification of groups of selected executable rule files. The system of the invention determines the category of the customer order and reads, from the rule selection repository, a group of selected executable rule files that correspond to the identified category of the customer order. The group of selected executable rule files are executed to check the conformance of the customer order. Execution results are stored in a status repository for subsequent retrieval and analysis.

[0009] According to a first aspect of the present invention, there is provided a method for testing at least one data item in a transaction order against at least one business logic rule, the method including the steps of creating a repository of executable rules, each executable rule adapted to encode a business logic rule, listing a subset of executable rules to be used in checking the transaction order, at least one listed executable rule being adapted to test the at least one data item against at least one business logic rule, locating the listed subset of executable rules in the repository, causing the at least one executable rule of the subset to test the at least one data item against the at least one business logic rule, and indicating whether the at least one data item conforms to the at least one business logic rule.

[0010] According to a second aspect of the present invention, there is provided a computer program product for use in a computer system operatively coupled to a computer readable memory, the computer program product including a computer-readable data storage medium tangibly embodying computer readable program code for directing the computer to for test at least one data item in a transaction order against at least one business logic rule, the code including code for instructing the computer system to create a repository of executable rules, each executable rule adapted to encode a business logic rule, code for instructing the computer system to list a subset of executable rules to be used in checking the transaction order, at least one listed executable rule being adapted to test the at least one data item against at least one business logic rule, code for instructing the computer system to locate the listed subset of executable rules in the repository, code for instructing the computer system to cause the at least one executable rule of the subset to test the at least one data item against the at least one business logic rule, and code for instructing the computer system to indicate whether the at least one data item conforms to the at least one business logic rule.

[0011] According to a third aspect of the present invention, there is provided a computer system having a computer readable memory, the system for testing at least one data item in a transaction order against at least one business logic rule, the system including executable code for placement in the memory, a repository of executable rules, each executable rule adapted to encode a business logic rule, a listing of a subset of executable rules to be used in checking the transaction order, at least one listed executable rule being adapted to test the at least one data item against at least one business logic rule, wherein the executable code includes: means for locating the listed subset of executable rules in the repository, means for causing the at least one executable rule of the subset to test the at least one data item against the at least one business logic rule, and means for indicating whether the at least one data item conforms to the at least one business logic rule.

[0012] A better understanding of these and other aspects of the invention can be obtained with reference to the following drawings and description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Reference is made to the accompanying drawings which show, by way of example, embodiments of the present invention, and in which:

[0014] FIG. **1** depicts an example of the prior art;

[0015] FIGS. **2**A and **2**B depict a computer system and subsystems of the computer system for operation with various embodiments of the invention;

[0016] FIGS. **3**A and **3**B depict an embodiment and a preferred embodiment of the invention;

[0017] FIGS. **4**A and **4**B depict a script file having a business logic rule, and a method for converting the script file to a source code file;

[0018] FIGS. **5**A and **5**B depict a source code file created by converting the script file of FIG. **4***a;*

[0019] FIGS. **6**A and **6**B depict a rule selection repository;

[0020] FIG. **7** depicts a flowchart of an operation of a rule engine;

[0021] FIG. **8** depicts a flowchart of an operation of a rule generator;

[0022] FIG. **9** depicts a flowchart of an operation of an execution analyser;

[0023] FIG. **10** depicts a rule selection repository enabled for dynamic rule selection; and

[0024] FIG. **11** depicts a flowchart of an operation for dynamically selecting rules.

DETAILED DESCRIPTION

[0025] Referring to FIG. **1**, there is depicted a prior art method for checking whether data, such as customer order **108** for transacting financial instruments, conforms to various rules which are encoded in source code **102**. The computer programmed instructions, hereinafter called 'instructions' of source code **102** include "if, then, else" style of instructions which are executed serially or can include branching statements for bypassing particular groups of instructions to suit a specific programming need. When the encoded rules must be changed, an experienced programmer modifies the instructions of source code **102** and uses compiler **104** to compile source code **102** to generate executable code **106** that replaces an older version of executable code. The newly generated executable code **106** is tested to ensure that the modified source code works properly and does not negatively impact the unmodified source code. Then, the tested source code can be used with the customer order **108**.

[0026] Executable code **106** examines the customer order **108** and may use related information that is useful for checking the conformance of the customer order **108**. The related information can be a market quotation **110** for a quote to transact financial instruments mentioned in customer order **108** or can be data from a database **112** containing customer specific information, such as account numbers and the like. After the executable code **106** examines customer order **108**, a market quotation **110**, and data from database **112**, executable code **106** proceeds to check whether customer order **108** conforms to the encoded rules. Executable code **106** provides a status indicator **114** for indicating whether customer order **108** conforms to the encoded rules.

[0027] The main disadvantage of using the prior art is that when the rules need to be changed, an experienced computer programmer must update or modify source code **102**. The frequency of changing the encoded rules occurs on a very frequent basis in which the source code **102** must be recompiled to generate new executable code **106**.

[0028] Referring to FIG. **2**A, there is depicted an embodiment of a computing platform in which various embodiments of the invention operate. The computing platform is a system that includes a conventional computer system **200** operationally coupled to a networked computer **218** via suitable network connections **212**, **216** and network **214**. Network **214** is a conventional network such as a local area network, wide area network, intranets, Internet, and the like, or a convenient combination thereof. Essentially, the network **214** provides a convenient mechanism for transporting data, such as customer orders for transacting a financial instrument, to the computer system **200**. It will be appreciated that in another embodiment of computer system **200**, computer **200** is not connected to the network **214** via network connection **212**, provided the data or customer order is entered directly to the memory of computer system **200** via a keyboard/mouse **206** or via a removable computer readable medium, such as a floppy disk **210**. For convenience, aspects of the present invention can be distributed amongst various networked computers interacting with a computer system **200** via network **214** or a combination of networks. Preferably, a majority of the invention will be implemented in computer system **200**. Computer system **200** includes a computer **204** which communicates with various output devices such as a display terminal **202** or a printer **208**, with the network **214**, and with various input devices, such as keyboard/mouse **206**, or floppy disk **210**. Other devices can include various computer peripheral devices such as a scanner, CD-ROM drives, and the like.

[0029] Referring to FIG. 2B, there is depicted an embodiment of computer **204** that includes a bus **224** that operationally interconnects various subsystems or components of the computer **204**, such as a central processing unit (CPU) **220**, a memory **222**, a network interface **226**, and an input/output interface **228**.

[0030] CPU **220** is a commercially available CPU suitable for operations described herein. Other variations of CPU **220** can include a plurality of CPUs. Suitable support circuits or components can be included for adapting the CPU **220** for optimum performance with the subsystems of computer **204**.

[0031] Input/output interface **228** enables communication between various subsystems of computer **204** and various I/O devices, such as keyboard/mouse **206**. Input/output interface **228** includes a video card for operational interfacing with display terminal **202**, and preferably a disk drive unit for reading suitable removable computer-readable medium, such as a floppy disk **210**, or CD. The removable medium provides programming instructions for subsequent execution by CPU **220** to configure and enable computer **204** to achieve the functions of the invention, or can provide removable data storage if desired.

[0032] Network interface **226**, in combination with a communications suite **232**, enables suitable communication between computer **204** and other computers operationally connected via network **214**. Examples of a conventional network interface can include an Ethernet card, a token ring card, a modem, or the like. Optionally, network interface **226** may also enable retrieval of transmitted programming instructions or data to configure and enable computer **204** to achieve the functions of the invention. Optionally, aspects of the invention can be enabled in various computer systems operationally networked to form a distributed computing environment to achieve the functions of the invention.

[0033] Memory **222** includes both volatile and persistent memory for storage of an embodiment **234** of the invention as depicted in FIG. 3A, and a preferred embodiment **240** of the invention as depicted in FIG. 3B. Embodiments **234** and **240** each include computer programmed instructions **236** and **242** respectively for instructing the CPU **220**, and include data structures **238** and **244** respectively such as databases or lookup tables. Memory **222** also includes operating system **230**, and communications suite **232**. Preferably, memory **222** includes a combination of random access memory (RAM), read only memory (ROM), and a hard disk storage device. It will be appreciated that programmed instructions **236** and **242** can be delivered to memory **222** from an input/output device, such as a floppy disk **210** inserted in a floppy disk drive via input/output interface **228**, or downloaded to memory **222** from network **214** via network interface **226**. Operating system **230** suitably co-operates with CPU **220** to enable various operational interfacing with various subsystems of computer **204**, and for providing various functionality, such as multitasking chores and the like. Communications suite **232** provides, through interaction with operating system **230** and network interface **226**, suitable communications protocols to enable appropriate communications with networked computing devices via network **214**, such as TCP/IP, ethernet, token ring, and the like.

[0034] Referring to FIG. 3A, there is depicted a system block diagram of an embodiment of the invention. The embodiment is depicted as embodiment **234** of FIG. 2B. The invention provides a method for testing at least one data item in a transaction order against at least one business logic rule. The invention also provides a computer program product for use in a computer system operatively coupled to a computer readable memory, the computer program product including a computer-readable data storage medium tangibly embodying computer readable program code for directing the computer to for test at least one data item in a transaction order against at least one business logic rule. The invention also provides a computer system having a computer readable memory, the system for testing at least one data item in a transaction order against at least one business logic rule.

[0035] Source code **381** contains instructions which are compiled by compiler **382** to generate executable code **383**. Executable code **383** is only generated one from source c ode **381**, and no matter how frequently the business logic rules need to be identified, changed, added, removed or the order in which the rules are executed it is not required to modify source code **381** and regenerate executable code **383**. In this manner, executable code **383** remains constant, as will be explained below, unless additional functions are added or removed to suit other particular requirements of executable code **383**.

[0036] The system reads data **384**, which can be a customer order to transact financial instruments such as stocks, bonds and the like. It will be appreciated that data **384** can be one or more data files, and can also be a customer order to purchase pharmaceutical drugs, vehicles, real estate, customer goods, and the like. The system can also read other pertinent data which can be available from other databases **385** and **386**. For the example that the data **384** is a customer order to transact financial instruments, database **385** can provide a related market quotation for the customer's transaction and database **386** can provide related customer information such as account numbers and the like.

[0037] Group **388**, which can be generated and managed by executable code **383**, includes a location, such as a lookup table, database, or repository, for containing individually executable rules which are identified or labelled as "Rule #1" to "Rule #N' inclusive. The group of rules **388** can also be called a repository. The repository is created for holding executable rules whereby each executable rule is adapted to encode a business logic rule. Each rule of group **388** is individually executable and includes a business logic rule. It will be appreciated that a rule of group **388** can include more than one business logic rule.

[0038] Listing of rules **389** is a convenient lookup table or database and the like having identifiers for identifying a specific subset of rules from the group **388**, in which the identified subset of rules are to be executed after executable code **383** reads listing **389**. Listing **389** is a listing of a subset of executable rules to be used in checking the data **384** (e.g. transaction order), wherein at least one listed executable rule is adapted to test the at least one data item against at least one business logic rule, and executable code **383** locates the listed subset of executable rules in the repository **388**. Executable code **383** looks up the identified subset of rules of listing **389** and then locates the identified subset of rules from the group **388**. It will be appreciated that the group of rules **388** can be merged with executable code **383** into one single unit of executable code. Preferably, group **388** is kept separate from executable code **383** for simplicity of operation. Executable code **383** requests only the identified rules (being identified from the listing **389**) from group **388** and causes execution of their encoded business logic rules to check conformance of data **384**. Once the executable code **383** has caused the execution of executable rules, the executing executable rules check whether the data **384** conforms to the business logic rules encoded in the executing rules. Executable code **383** causes the at least one executable rule of the subset to test the at least one data item against the at least one business logic rule.

[0039] A status indicator **387** indicates whether the data **384** conforms to the business logic rules encoded in the identified rules of listing **389**. The system is adapted to indicate whether at least one data item conforms to the at least one business logic rule. The indication can be provided by executable code **383** or directly from an executable rule. Indicator **387** can be updated by the executing executable rules or by the executable code **383**. Advantageously, executable code **383** is never changed. What changes is the individually executed rules and the listing that identifies the individually executed rules. When the rules need to be identified, changed, deleted or new rules need to be added to group **388**, a user can manage group **388** and listing **389**.

[0040] To create new rules for placement in group **388**, a user writes source code **391** for a rule and then uses compiler **392** to compile code **391** to created executable code **393** which is then subsequently placed in group **388**. Then the user can proceed to identify the newly created executable rule in listing **389** if desired. Listing **389** can be organized in any suitable manner such as grouping specific identified rules into subgroups for sake of simplicity. The subgroup of identified rules can be used for checking the conformance of data **384** that belongs to a category of data. Alternatively, a new listing **390** can be used for checking data that belongs to another category of data.

[0041] Referring to FIG. 3B, there is depicted a preferred embodiment of the invention. System module **300** includes rule generator **310**, rule repository **320**, rule selection repository **330**, rule engine **340**, data repository **350**, and status repository **360**. The arrows in FIG. 3B indicate the paths for exchanging data between the modules of system **300**. System **300** is depicted as embodiment **240** of FIG. 2B.

[0042] Rule generator **310** and rule engine **340** (modules **310** and **340**) include programmed instructions which can be enabled as dedicated electronic circuits or subsystems operationally coupled to CPU **220**. Preferably, modules **310** and **340** are conveniently enabled as executable programmed instructions stored in memory **222** of FIG. **2**, for directing the CPU **220** to achieve the desired functions and results of the preferred embodiment of invention. The programmed instructions of modules **340** and **310** are created by using compilers **302** and **305** respectively to compile source code **301** and **304** respectively to generate executable code of modules **340** and **310** respectively. Preferably, the source code **301** and **304** of modules **340** and **310** respectively are written in an object oriented computer programming language such as Java for convenience of programming. Rule repository **320**, data repository **350**, and status repository **360** (modules **320**, **350**, and **360**) are enabled as data structures and they are stored in memory **222** in data structures **238** of FIG. **2**. Optionally, these modules can also be enabled in dedicated electronic circuits and subsystems. The structure of these modules is described below. It will be appreciated that modules **310**, **320**, **330**, **340**, **350**, and **360** can reside in a distributed computing environment, such as operationally networked computer systems, so that the modules can co-operate with each other to achieve the purposes of the invention.

[0043] Rule generator **310** is used for creating executable rule files (ERFs) **316** for subsequent placement in the rule repository **320**. Script files **312** each have business logic rules (BLRs) for checking an aspect of a customer order for transacting a financial instrument in conjunction with market quotation for the financial instrument. Preferably, and for the sake of convenience, a script file is a structured document, such as a text file, or more conveniently, it is an XML formatted file that is written in a suitable markup language having data tags, such as Extensible Mark-up Language (XML). Essentially, a user uses the script file **312** to write or script business logic rules into the script file **312**. FIG. **4**A depicts an example of a script file **312**. For simplicity of programming, each BLR is defined in an individual script file **312**. Optionally, a script file **312** can include two or more BLRs. FIG. **4**B depicts a method for converting script file **312** into source code file **314**. The executable rules generated by rule generator **310** are subsequently placed in rule repository **320**.

[0044] To create source code files, the rule generator **310** can read and convert the script file **312** into a suitable corresponding source code file **314** having suitable high level source code written in a computer programming language. Preferably, each script file **312** is converted into a corresponding source code file **314**, and the high level source code is written in an object oriented programming language, such as Java. FIGS. **5***a* and **5***b* provide an example of a script code file and a source code file of an executable rule.

[0045] A suitable and compatible compiler can be used to compile the source code file **314** into a corresponding executable rule file **316** that can direct CPU **220** to perform business logic rule on a customer order. Preferably, the compiler can compile Java programmed source code into executable programmed code. An advantage provided by the invention is that the user who writes the script files **312** does not need to be familiar with computer programming languages. It is expected that the user is familiar with business logic that is needed to check customer orders for transacting financial instruments. The user is required to insert suitable business logic rules in the script file for subsequent conversion, by the rule generator **310**, into appropriate source code files **314**, and then subsequent conversion or compilation into an executable rule file (ERF) **316**. FIG. **7** provides an example of a flow chart that illustrates the operation of the rule generator **310**.

[0046] The rule repository **320** can be any convenient database and provides a data structure for suitably holding or containing a plurality of N available executable rule files (AERFs) **323**A-**323**N each being identifiable by a unique identification, such as a filename. Preferably, the executable rule files **323**A-**323**N stored in rule repository **320** are independently executable files. Executable rules **323**A-**323**N are shown to illustrate that each executable rule is separate and individually executable. The rule engine **340** will retrieve a plurality of suitable executable rule files, from the rule repository **320**, for subsequent testing of a customer order, in a manner to be detailed later. It will be appreciated that the rule repository **320** can be split into convenient subgroups and subsequently distributed over a plurality of networked computers. However, for a convenient explanation, the rule repository **320** is maintained as a whole in the memory of a single computer system. The rule engine **340** uses the rule repository **320** to obtain a suitable executable rule having the encoded business logic rule. The rule repository **320** is a convenient container for placing all of the available executable rules.

[0047] Rule selection repository **330** is a listing of selected AERFs from rule repository **320**, and provides a convenient data structure for M user-identified groups of selected available executable rule files **332**A-**323**M. Preferably, the rule selection repository **330** is a text file, and more preferably, the text file is formatted in Extensible Markup Language (XML) using data tags. Preferably, a user constructs a pair of group name data tags, each pair of group name tags for identifying a group of selected executable rule files, for example the group of selected AERFs **332**A. Preferably, nested or inserted within each pair of group name data tags are pairs of rule identification data tags, in which each pair of rule identification tags is used for identifying or selecting a name of a preferred executable rule file. Each selected available executable rule file that is identified between each rule identification data tag is available from the rule repository **320**. FIGS. **6**A and **6**B provide an example of a preferred embodiment of a rule selection repository enabled as a text file incorporating XML formatting and data tags. In summary, rule engine **340** examines the rule selection repository **330** to locate one or more identified or preferred executable rules, and the rule engine must subsequently locate the preferred executable rules from the rule repository **320**. Once the preferred executable rules are located in rule repository **320**, the rule engine executes the located preferred executable rules to check the conformance of the customer order. When the rules need to be changed, the rule selection repository, which can be a simple lookup table, can be modified to suit the current requirements. Advantageously, the executable code having the programmed instructions of rule engine **340** does not need to be regenerated. To adapt to the new requirements for checking the conformance of the customer order, either new executable rules are generated via rule generator **310** or the rule selection repository **320** is modified, or both actions can be taken as required, but the executable code of rule engine **340** is not regenerated.

[0048] To check whether a customer order conforms to the business logic rules, rule engine **340** reads, from the rule selection repository **330**, identification, such as a file name, of executable rule files from between each pair of rule identification data tags, and subsequently, the rule engine requests execution of identified executable rule files. When the number of executable rule files contained in the rule repository **320** is very large, it would be preferable that each group **332**A-**332**M be assigned to a corresponding category of customer orders. It may be desirable to organize customer orders into suitably convenient categories to reduce the quantity of rules that need to be executed. Also, it would be advantageous to execute certain rules that do apply to specific categories of customers orders.

[0049] It will be appreciated that a suitably structured file can be used as a rule selection repository **330**, in which the structure of the file would allow for convenient identification of the groups or subgroups of selected executable rule files, and allows a user to conveniently add, remove, or reorder the selected executable rule files. This feature advantageously allows a user to compile executable rule files when needed, and avoid recompiling an executable file for the rule engine **340**. If a recently compiled executable rule file fails to execute properly, a user can focus their debugging effort on the script file **312**, and avoid having to deal with the executable file for the rule engine **340**.

[0050] Each group of selected AERFs **332**A-**332**M corresponds to a specific category of customer orders, such as a first customer order category for transacting sale of a stock, a second customer order category for transacting purchases of stocks, and so on for bonds, mutual funds, options and the like. The organization of executable rule files into categories is used for simplicity and convenience of organization, where **332**A-**332**M have identifications of executable rule files. The group is used for checking conformance of a specific category of customer orders. Optionally, a single group of executable rule files can be used for testing all types of customer orders but at a potential disadvantage of added complexity for the user. Preferably, the rule selection repository **330** is a structured file or a document that is written in a suitable markup up language having data tags, such as the Extensible Mark-up Language (XML). The rule selection repository **330** is described in more detail with reference to FIGS. **6***a* and **6***b*.

[0051] Data repository **350** provides a convenient data structure for storing or containing input data, such as a plurality of J customer orders **352**A-**352**J. Rule engine **340** reads a customer order from repository **350**. It will be appreciated that the input data will be compared with suitably matching business logic rules, and the scope of this invention is not limited to merely checking customer orders for financial transactions. For ease of programming, it is preferred to categorize the customer orders into convenient categories, as explained earlier. A market quotation **354**A-**354**J is associated with a corresponding customer order **352**A-**352**J. As quotation provides a market condition of the customer order for a financial transaction, such as the price of a stock or a bond. A market quotation can reveal the market conditions at the time the associated customer order was placed.

[0052] Status repository **360** provides a convenient mechanism for indicating whether a customer order **352**A-**352**J conforms to business logic rules as implemented and executed in executable rule files **316**. Rule engine **340** places the indicator in repository **360**. After execution of an AERF, the executed AERF provides an execution result, in which the rule engine can store the execution result in status repository **360** or the executed rule file can store its own execution result in the status repository **360**. The status indicators **361** indicate whether the customer orders conform to the business logic rules encoded in the executed rule files **316**. Preferably, the status indicators **361** contain the status execution of the executed rule files associated with a group of selected AERFs **332**A-**332**M.

[0053] Rule engine **340** can transmit a message to a requesting application, which had previously requested the rule engine **340** to check conformance of the customer order. The message can show that one of the status indicators **361** is available for review by the requesting application so that the requesting application can decide whether to forward the analysed customer order to a order fulfilment system or forward the customer order and the status indicator back for modification and subsequent re-testing by rule engine **340**. The rule engine **340** can be adapted to perform an analysis of the status indicators **361**, and the rule engine **340** can decide whether to send a customer order to the legacy system, such as an order fulfilment system, or send the customer order back for modification.

[0054] It will be appreciated that if nonconforming customer orders were to be submitted to the legacy system, there would be a possibility that the legacy system would reject nonconforming customer orders. When customer orders do not conform to the executed business logic rules, the status indicators **361** can be queried by the user to provide the reasons why the customer order does not conform so that appropriate corrective action can be taken to appropriately modify the nonconforming customer order.

[0055] Rule engine **340** is used for checking whether customer orders **352**A-**352**J conform to business logic rules (BLRs). The rule engine **340** can be adapted to analyse various types of data. In the preferred embodiment, the data is a customer order for transacting a financial instrument, such as:

Order type:	buy
Quantity of shares:	1,000
Stock symbol:	IBM
Price per share:	$150
Broker ID:	987
Account No.	ABC1234
Account Type:	tax sheltered
Customer Name:	John Smith

[0056] In the preferred embodiment, the Customer Name is not contained in the order because the Account ID would be sufficient. A joint account can have two or more customer names.

[0057] The data that is provided in the above example includes a set of data elements, such as 'order type', 'quantity of shares', 'Stock symbol', etc., and each data element has a corresponding data value, such as 'buy', '1,000', 'IBM', etc.

[0058] A user can submit a customer order to a financial broker and request fulfilment of the submitted order. To fulfil the submitted order, the broker can obtain related business factor data. For example, the related business factor data can be a quotation for the financial instrument, such as:

Stock symbol:	IBM
Bid price:	$ 140
Ask price:	$ 170
Closing price:	$ 140
Volume of shares:	1,500,000

[0059] Rule engine **340** includes various sub-modules to achieve various desirable functions, such as a reader **341**, a determinator **342**, a locator **344**, a requestor **345**, a receiver **346**, an execution analyser **347**, a transmitter **348**, and a dynamic rule selector **349**. It will be appreciated that the sub modules **341** to **349** of rule engine **340** can be distributed in a convenient manner throughout a distributed computer networking environment. However, for the convenience of describing the preferred embodiment of the invention, the sub modules **341** to **349** of rule engine **340** reside in computer **204** (FIG. **2**A), and more preferably in memory **222** of computer **204**, in which the sub modules are conveniently enabled as various source code files having logic, in which the source code files are subsequently compiled into executable files that achieve the functions of the sub modules, as known to skilled persons in the art of computer programming languages and computer systems in general. FIG. **8** provides an example of a flow chart for illustrating the general operation of the rule engine **340**.

[0060] The rule engine **340** includes a reader **341** used for reading a customer order **352**A-**352**J. Determinator **343** is used for determining a category of the read customer order. Locator **344** is used for locating, from the rule selection repository **330**, a group of user-selected executable rule files **332**A-**332**M that corresponds to the determined category of the read customer order.

[0061] Requestor **345** is used for locating, from the rule repository **320**, and initiating execution of available executable rule files **316** that are identified in a group of the user-selected executable rule files **332**A-**332**M from rule selection repository **330**. Subsequent execution of each identified AERF obtains data from the customer order that is preferably located in the data repository **350**.

[0062] Receiver **346** is used for receiving or obtaining an execution result that is contained in the status indicators **361**. Preferably, the rule engine **340** includes execution analyser **347** responsive to the execution result for each executed executable rule file. The execution analyser **347** can include logic to determine whether the rule engine should execute the remaining unexecuted executable rule files of a group **332**A-**332**M, depending on the execution result of the previously executed executable rule file. For example, if an execution result indicates the executed business logic of the first executable rule of group **332**A was satisfied, then the execution analyser **347** can direct the rule engine **340** to execute the next executable rule file identified in group **332**A. Alternatively, if the execution result indicates the executed business logic was not satisfied, the execution analyser **347** can direct the rule engine **340** to stop further executions of unexecuted executable rule files and indicate that one of the status indicators **361** is available for analysis so that the customer order can be adjusted and resubmitted for additional testing by the rule engine **340**. The operation of the rule execution analyser is depicted in the flowchart of FIG. **9**.

[0063] The execution analyser **347** provides enhanced and beneficial functionality to the rule engine **340**. However, it will be appreciated that the execution analyser **347** can be disabled to remove these preferred enhancements to realize a simpler operation of the rule engine **340**.

[0064] Preferably, transmitter **348** is used for transmitting availability of the status indicators **361**, located in status repository **360**, to a requesting application that submitted a request to check the conformance of a customer order against business logic rules. Optionally, the rule engine **340** can be adapted to transmit status indicators **361** to the requesting application.

[0065] Preferably, rule engine **340** includes a dynamic rule selector **349** used for sequencing a preferred sub-selection of executable rule files of a group **332**A-**332**M. In the preferred embodiment, the dynamic rule selector **349** is used for checking requests to change or modify operational or system parameters of system **300** of FIG. **3**. However, it will be appreciated that the dynamic rule selector **349** can be used for examining customer orders. The operation of the dynamic rule selector **349** is illustrated in the flowchart of FIG. **11**. Preferably, the dynamic rule selector **349** engages when rule selection repository is suitably adapted with keyed information, as will be explained below.

[0066] Referring to FIG. **4**A, there is depicted an embodiment of a script file **312** of FIG. **3**B. The script file is implemented in a text file incorporating XML formatting with data tags. Preferably, the business logic rules are inserted between a pair of data tags in an XML document. An XML file is merely a text file that contains strings of text in which each string of text is encapsulated within a pair of data tags. Names of the data tags provide the meaning of the encapsulated text. It will be appreciated that other file structures can be adapted for usage with the invention, provided that the structure of the file gives meaning to the string of text. Exemplary script file **400** includes a header **402**, a rule severity indicator or a rule status indicator **404**, a first scripted text string **406** representing a factor used for validating the subject (i.e., the data that the rule engine **340** will be checking or validating against the validation logic), a second scripted text string **408** representing the source and the description of the subject, and a third scripted text string **410** representing the validation logic. The header **402** includes a first line that is a standard XML file header, which is not specific to the rule engine **340**, and a second line that includes rule syntax validation. The rule severity indicator or a rule status indicator **404** is used by the rule engine **340** to determine an appropriate execution path within the set of rules depending on the validation results of a currently checked portion of the subject. The first scripted text string **406** is used for retrieving predefined values to be used by the third scripted text **410** for validation. The second scripted text string **408** is used for retrieving data supplied by the client to be used by the third scripted text **410** for validation. The third scripted text string **410** describes the actual validation logic that will be used to validate a portion of the subject.

[0067] Referring to FIG. **4**B, there is depicted a preferred method for converting a script file such as script file **400** into source code file **314** of FIG. **3**B. The process of conversion begins in step S**432**. In step S**434**, the script file **400** is read. In step S**436**, elements of the script file are identified. FIG. **4**A depicts various values of elements of script file **400** as blocks **408**A, **408**B and **408**C. The script file **400** is an XML document. However, any document having a predetermined structure will suffice. XML technology was chosen because the data tags help impose structure into the document. Element value **408**A is "com.ibm.eb2engine.rm.Orders VDO" for element "<DATA CLASSNAM=" . . . "/>. In step S**438**, a determination is made whether each identified element conforms to a list of predetermined element identifiers. Since the preferred embodiment is using XML documents, DTD (Document Type Definition) is used to check whether the elements of script file **400** conform to the predetermined types of elements that will be acceptable. If a user attempts to use an element name that is not defined in the DTD, then an error message is created and the script file is rejected in step S**448**. The process then ends with step S**446**.

[0068] It will be appreciated that an XML parser can be used for identifying elements of the script file which is an XML document. The DTD defines the elements that are allowable, the sequence of the elements, the number of allowable occurrences of the element, and what element values can be allowed for an element. The DTD is used to check whether the writer of the script file **312** followed or used the acceptable element names and element values.

[0069] Otherwise, (i.e., the elements conform), in step S**440** a source code template is read. The source code template has predetermined locations in which the element values will be placed in a later step. In step S**442**, the identified element values of the script file are inserted into corresponding predetermined locations in the template. For example, element value **408**A will be inserted into block **524** of FIG. **5**A. Element value **408**B will be inserted into block **526**. Element value **408**C will be inserted into block **528**. In step S**444**, the process writes the source code file which is the template having the inserted element values.

[0070] Referring to FIGS. **5**A and **5**B, there is depicted an example of various portions of a source code file **314**. Preferably, the rule generator **310** converts the script file **312** into the source code file **314** that is written in an object oriented computer programming language, such as Java. Source code portion **502** corresponds to section **406** of FIG. **4**A. Source code portion **500** corresponds to section **408** of FIG. **4**A. Source code portion **504** corresponds to section **410** of FIG. **4**A. The rule generator **310** includes a converter module for achieving the functional task of converting the script file **312** into the source code file **314**. FIG. **4**B depicts a method for converting script files into source code files.

[0071] Referring to FIGS. **6**A and **6**B, a preferred embodiment of the rule selection repository **330** is illustrated. In this embodiment, the rule selection repository **600** is a text file incorporating XML formatting and data tags. The rule selection repository **600** is illustrated as extending between FIGS. **6***a* and **6***b*. The rule selection repository **600** includes a header section **602**, a first group **604** having subgroups **606**, **608**, **610**, and a second group **612** having subgroups **614** and **616**, and an footer **620**.

[0072] Identification, preferably a file name, of an executable rule file of the executable rule files **316** of FIG. **3**B is indicated in rule selection repository **600** by using a pair of rule identification data tags: <RULE NAME="name of executable rule file"/>.

[0073] The identification of a plurality of executable rule files **316** can be sequenced in a preferred order to tale advantage of the functions provided by an execution analyser **347** or a dynamic rule selector **349**, as will be detailed later in this description. Briefly, the execution analyser **347** will read an execution status of an executed executable rule file and subsequently determine whether to request execution of the remaining unexecuted executable rule files being identified in the appropriate group of selected AREFs **332**A-**332**M. Briefly, the dynamic rule selector **349** will read and 'dynamically' determine which data elements present within an invalidated subject actually match up with names of the executable rule file from the appropriate group **332**A-**332**M, and subsequently execute only the matching executable rule files and bypass the remaining unmatched executable rule files. Currently, the dynamic rule selector **349** has been implemented for a system configuration/parameter list (an example is depicted in FIG. **10**). The parameter list can include system parameters such as user passwords, number of lines to display on a computer monitor and the like. If required, it will be appreciated that selector **349** can be implemented for validating customer orders.

[0074] The identification of one of the groups of selected AREFs **332**A-**332**M of rule repository **320** is indicated in repository **600** within the following group name data tags: <LAYERGROUP ENTITYNAME="layer group name">

[0075] Identified group **604** is named "ClOptionOrder". Group **604** is used for checking a customer order for transacting an option. Group **604** identifies subgroup **606** named "cloplayer1", subgroup **608** named "cloplayer2", and subgroup **610** named "clopcxr". Identified group **612** identifies subgroup **614** named "clmflayer1", subgroup **616** named "clmflayer2". Identification of subgroups **606**, **608**, **610**, **614**, **618** is indicated in repository **600** as the following pair of subgroup identification data tags: <LAYER NAME="subgroup name">

[0076] Each subgroup **606**, **608**, **610**, **614**, **618** is used to identify a set of file names of executable rule files located in rule repository **320**. When a customer order for transacting an option is received by system **300**, the rule engine **340** identifies that a category of the customer order is 'option' and locates group **604** corresponding to the category 'option'. Layers, such as "cloplayer1", represent a logical grouping of several rules, which do not correspond to a data element of a subject undergoing validation, such as a customer order. The motivation to create the layers, such as "cloplayer1" is for convenience in that some rules logically belong to a group of their own in that they only make sense when executed together as a group of rules.

[0077] Referring to FIG. **7**, there is depicted a preferred method for operating the rule generator **310** of FIG. **3**B. At step S**700**, a user begins the process for creating executable rule files. In step S**702**, the user writes business rule logic into the script file **312**. Preferably, the script file **312** is formatted using the XML standard which adheres to a suitable style sheet. It will be appreciated that the script file **312** represent a convenient mechanism to identify the written business logic rules scripted by the user. In step S**704**, the rule generator **310** reads and converts the script file **312** into a suitable source code file **314**. FIG. **4**B depicts a method for converting script files into source code files.

[0078] In step S**706**, the rule generator **310** compiles the source code file into a corresponding executable rule file **316**. In step S**708**, the user can decide to script another script file **312**, or decide to stop scripting script files **312** altogether.

[0079] Referring to FIG. **8**, there is depicted a preferred operation of rule engine **340** of FIG. **3**B. In step S**800**, the rule engine **340** is initialized and the process starts. In step S**802**, a request to check a customer order was received by the rule engine **340**, perhaps from another computer application or from a keyboard signal. The rule engine **340** identifies a category of the customer order that needs to be checked for conformance to business logic rules. In step S**804**, the rule engine **340** identifies one of the groups of selected AREFs **332**A-**323**N, the group corresponding to the identified category of the customer order. In step S**806**, the rule engine **340** requests or begins a process for executing the executable rule files that are identified in the identified group. In step S**808**, after the identified executable rule files have completed their execution, the rule engine **340** receives a notification that the identified executable rule files have completed their execution. Preferably, the executed rule files place their execution results in the status repository **360**, preferably into a corresponding status indicator of the status indicators **361**.

[0080] Optionally, rule engine **340** could transmit the status indicator to the requesting application that the execution results are available for review by the requesting application. In turn, the requesting application can review the execution results and, depending on the types of execution results contained in the status indicator, determine whether to forward the analysed customer order back for modification, or whether to forward the analysed customer order to an existing legacy system for transaction execution of the analysed customer order. Optionally, the rule engine **340** can be adapted to decide whether to forward the customer order for transaction execution, by including an appropriate module to handle this extra functionality.

[0081] Referring to FIG. **9**, there is depicted a preferred operation of the execution analyser **347** of the rule engine **340** of FIG. **3**B. In steps S**900** and S**901**, the execution analyser **347** obtains and reads the status indicator of an executed executable rule file from the status indicator **361**. In step S**902**, the execution analyser **347** reads an execution result of 'PASS' from the status indicator. 'PASS' indicates that a data element of the customer order satisfactorily conforms to the executed executable rule file, and that the next available executable rule file of the current group of selected AREFs can be executed (or the next group can be executed), as indicated in step S**914**. If the execution result is not 'PASS', then the operation continues to step S**904**.

[0082] In step S**904**, the execution analyser **347** reads an execution result of 'INFO' from the status indicator. 'INFO' indicates that the data element of the customer order conforms to the executed executable rule file, and that the next available executable rule of the current group of selected AREFs can be executed (or the next group can be executed), as indicated in step S**916**; however, the data element conforms reasonably but there might be something about the customer order that the user may wish to review. If the execution result is not 'INFO', then the operation continues to step S**906**.

[0083] In step S**906**, the execution analyser **347** reads an execution result of 'WARN' from the status indicator. 'WARN' indicates that the next executable rule can be executed, but attention should be placed to the execution results stored in the status indicator **361**, as shown in step S**918**. If the execution result is not 'WARN', then the operation of the execution analyser **347** continues to step S**908**.

[0084] In step S**908**, the execution analyser **347** reads an execution result of 'ERROR' from the status indicator. "ERROR' indicates that the unexecuted rules of the current subgroup of the current group of selected AREFs can be executed, but remaining unexecuted executable rule files that are identified in remaining subgroups are not to be executed, as shown in step S**920**. The execution result indicates something is wrong with the customer order, but the remaining executable rule files of the current subgroup can be executed, as shown in step S**920**. If the execution result is not 'ERROR', then the operation of the execution analyser **347** continues to step S**910**.

[0085] In step S**910**, the execution analyser **347** reads an execution result of 'HARDSTOP'. 'HARDSTOP' indicates that any remaining unexecuted executable rule files are not to be executed because the execution result indicates something seriously incorrect with the customer order, as shown in step S922. Processing then continues to step S912 where the process stops and control is passed back to the rule engine **340**.

[0086] Referring to FIG. **10**, illustrated is a preferred embodiment of a rule selection repository **330** enabled for dynamic selection of executable rule files of the groups of selected AREFs **332A-332M**. The preferred rule selection repository **1000** includes a group **1002** enabled for dynamic selection of executable rules **316**. The name of group **1002** is 'ParameterLst'. It is a group **1002** of identified or selected executable rules organized into various subgroups, for example, subgroups **1004** and **1006**. Group **1002** is used for changing the system parameters of system **300** of FIG. **3**B. Subgroup **1004** is used for changing system parameters dedicated to monitoring various market conditions. Subgroup **1006** is used for changing system parameters for a historical review of transacted customer orders. An identified rule name **1008**, located in subgroup **1004**, is a particular executable rule file for validating the support phone number of the broker. Ideally, when one or only a few system parameters need to be changed, it would be preferable to execute the rules that match the particular system parameter that needs to be changed.

[0087] Referring to FIG. **11**, there is depicted a preferred operation of dynamic rule selector **349** of the rule engine **340** of FIG. **3**B. In steps **S1100** and **S1102**, the process begins and rule engine **340** determines a category of the input data, the input data can be either a customer order or a request to change the system parameters of system **300** of FIG. **3**B. In step **S1104**, the rule engine **340** determines that the identified category listed in the rule selection repository is enabled for dynamic rule selection by a dynamic rule selector **349**, in which case operation continues to step **S1108**; otherwise, processing continues to step **S1106** in which case the rule engine operates as previously described.

[0088] In step **S1108**, the dynamic rule selector **349** selects identified executable rules, such as identified executable rule file **1008** of FIG. **10**, that are listed in the group being enabled for dynamic rule selection, such as group **1002** of FIG. **10**, in which the selected identified executable rules match up with the data elements that are present within the request to change the system parameters.

[0089] In step **S1110**, the dynamic rule selector **349** provides a list of matching executable rule files for the rule engine **340** to execute. In step **S1112**, the dynamic rule selector **349** passes system control back to the rule engine **340**.

[0090] The system provides a modularized approach which does not require an experienced programmer to update the listing of executable rule files in response to requirements for periodically incorporating new business logic, or reordering the rules. Advantageously, a non-programmer can operate and adapt the invention to execute preferred executable rule files as required.

[0091] Advantageously, the present invention reduces associated transaction expenses and improves customer service. Additionally, the invention also reduces complexity of usability for modifying or changing sequences of desired rule execution. The invention provides a mechanism for determining whether a submitted customer order complies with 'know your client' guidelines, for determining whether customers are covered for their buy/sell order, and for determining whether the composition of the customer order conforms to business logic rules.

[0092] It will be appreciated that variation of some elements are possible to adapt the invention for specific conditions or functions. The concepts of the present invention can be further extended to a variety of other applications that are clearly within the scope of this invention. Having thus described the present invention with respect to a preferred embodiment as implemented, it will be apparent to those skilled in the art that many modifications and enhancements are possible to the present invention without departing from the basic concepts as described in the preferred embodiment of the present invention. Therefore, what is intended to be protected by way of letters patent should be limited only by the scope of the following claims.

1. A computer program product, comprising a computer usable storage medium having a computer readable program code stored therein, said computer readable program code containing instructions that when executed by a processor of a computer system implement a method for processing a customer order pertaining to a transaction, said method comprising:

identifying a category of the customer order;

identifying a group of executable rule files corresponding to the identified category, each executable rule file comprising at least one business logic rule, said group of executable rule files stored in a repository, said group of executable rule files consisting of a first subgroup of executable rule files and at least one remaining subgroup of executable rule files, said first subgroup of executable rule files consisting of a first executable rule file and at least one remaining executable rule file, each subgroup of the at least one remaining subgroup of executable rule files comprising one or more executable rule files;

selecting the first subgroup followed by selecting the first executable rule file in the first subgroup;

after said selecting the first executable rule file in the first subgroup, executing the first executable rule file in the first subgroup with respect to the customer order prior to execution of any other executable rule file in the group of executable rule files, wherein executing any executable rule file of the group of executable rule files with respect to the customer order comprises applying the at least one business logic rule of said any executable rule file to the customer order;

receiving an execution result of the executed first executable rule file;

first determining whether the execution result is PASS;

if said first determining determines that the execution result is PASS, then executing a next executable rule file of the at least one remaining executable rule file in the first subgroup with respect to the customer order;

if said first determining determines that the execution result is not PASS, then second determining whether the execution result is INFO;

if said second determining is performed and determines that the execution result is INFO, then selecting a next executable rule file of the at least one remaining executable rule file in the first subgroup and executing the selected next executable rule file with respect to the customer order, wherein the execution result of INFO denotes a need for reviewing an aspect of the customer order;

if said second determining is performed and determines that the execution result is not INFO, then third determining whether the execution result is WARN;

if said third determining is performed and determines that the execution result is WARN, then picking the next executable rule file of the at least one remaining executable rule file in the first subgroup and executing the picked next executable rule file with respect to the customer order, wherein the execution result of WARN denotes a need for reviewing results from the executed first executable rule file;

if said third determining is performed and determines that the execution result is not WARN, then fourth determining whether the execution result is ERROR;

if said fourth determining is performed and determines that the execution result is ERROR, then choosing a next executable rule file of the at least one remaining executable rule file in the first subgroup, executing the chosen next executable rule file with respect to the customer order, identifying each subgroup of the at least one remaining subgroup of executable rule files, and inhibiting execution of each executable rule file in each identified subgroup of the at least one remaining subgroup of executable rule files;

if said fourth determining is performed and determines that the execution result is not ERROR, then fifth determining whether the execution result is HARDSTOP;

if said fifth determining is performed and determines that the execution result is HARDSTOP, then inhibiting execution of all executable rule files of the at least one remaining executable rule file in the first subgroup with respect to the customer order and further inhibiting execution of the one or more executable rule files in each subgroup of the at least one remaining subgroup of executable rule files with respect to the customer order;

if said fifth determining is performed and determines that the execution result is not HARDSTOP, then stopping performance of said method;

wherein said first determining determines that the execution result is not PASS, wherein said second determining determines that the execution result is not INFO, wherein said third determining determines that the execution result is not WARN, and wherein said fourth determining determines that the execution result is ERROR;

wherein said selecting the first subgroup comprises selecting a subgroup used for changing a plurality of system parameters dedicated to monitoring market conditions relevant to the transaction, wherein said executing the chosen next executable rule file comprises changing a first system parameter of the plurality of system parameters in the selected subgroup used for changing the plurality of system parameters dedicated to monitoring market conditions relevant to the transaction, wherein said identifying each subgroup of the at least one remaining subgroup of executable rule files comprises identifying a subgroup used for changing a plurality of system parameters for a historical review of the customer order, and wherein said inhibiting execution of each executable rule file in each identified subgroup of the at least one remaining subgroup of executable rule files comprises inhibiting execution of each executable rule file in the identified subgroup used for changing the plurality of system parameters for a historical review of the customer order.

2. A computer system comprising a processor and a computer readable memory unit coupled to the processor, said memory unit containing instructions that when executed by the processor implement a method for processing a customer order pertaining to a transaction, said method comprising:

identifying a category of the customer order;

identifying a group of executable rule files corresponding to the identified category, each executable rule file comprising at least one business logic rule, said group of executable rule files stored in a repository, said group of executable rule files consisting of a first subgroup of executable rule files and at least one remaining subgroup of executable rule files, said first subgroup of executable rule files consisting of a first executable rule file and at least one remaining executable rule file, each subgroup of the at least one remaining subgroup of executable rule files comprising one or more executable rule files;

selecting the first subgroup followed by selecting the first executable rule file in the first subgroup;

after said selecting the first executable rule file in the first subgroup, executing the first executable rule file in the first subgroup with respect to the customer order prior to execution of any other executable rule file in the group of executable rule files, wherein executing any executable rule file of the group of executable rule files with respect to the customer order comprises applying the at least one business logic rule of said any executable rule file to the customer order;

receiving an execution result of the executed first executable rule file;

first determining whether the execution result is PASS;

if said first determining determines that the execution result is PASS, then executing a next executable rule file of the at least one remaining executable rule file in the first subgroup with respect to the customer order;

if said first determining determines that the execution result is not PASS, then second determining whether the execution result is INFO;

if said second determining is performed and determines that the execution result is INFO, then selecting a next executable rule file of the at least one remaining executable rule file in the first subgroup and executing the selected next executable rule file with respect to the customer order, wherein the execution result of INFO denotes a need for reviewing an aspect of the customer order;

if said second determining is performed and determines that the execution result is not INFO, then third determining whether the execution result is WARN;

if said third determining is performed and determines that the execution result is WARN, then picking the next executable rule file of the at least one remaining executable rule file in the first subgroup and executing the picked next executable rule file with respect to the customer order, wherein the execution result of WARN denotes a need for reviewing results from the executed first executable rule file;

if said third determining is performed and determines that the execution result is not WARN, then fourth determining whether the execution result is ERROR;

if said fourth determining is performed and determines that the execution result is ERROR, then choosing a next executable rule file of the at least one remaining executable rule file in the first subgroup, executing the chosen next executable rule file with respect to the customer order, identifying each subgroup of the at least one remaining subgroup of executable rule files, and inhibiting execution of each executable rule file in each identified subgroup of the at least one remaining subgroup of executable rule files;

if said fourth determining is performed and determines that the execution result is not ERROR, then fifth determining whether the execution result is HARDSTOP;

if said fifth determining is performed and determines that the execution result is HARDSTOP, then inhibiting execution of all executable rule files of the at least one remaining executable rule file in the first subgroup with respect to the customer order and further inhibiting execution of the one or more executable rule files in each subgroup of the at least one remaining subgroup of executable rule files with respect to the customer order;

if said fifth determining is performed and determines that the execution result is not HARDSTOP, then stopping performance of said method;

wherein said first determining determines that the execution result is not PASS, wherein said second determining determines that the execution result is not INFO, wherein said third determining determines that the execution result is not WARN, and wherein said fourth determining determines that the execution result is ERROR;

wherein said selecting the first subgroup comprises selecting a subgroup used for changing a plurality of system parameters dedicated to monitoring market conditions relevant to the transaction, wherein said executing the chosen next executable rule file comprises changing a first system parameter of the plurality of system parameters in the selected subgroup used for changing the plurality of system parameters dedicated to monitoring market conditions relevant to the transaction, wherein said identifying each subgroup of the at least one remaining subgroup of executable rule files comprises identifying a subgroup used for changing a plurality of system parameters for a historical review of the customer order, and wherein said inhibiting execution of each executable rule file in each identified subgroup of the at least one remaining subgroup of executable rule files comprises inhibiting execution of each executable rule file in the identified subgroup used for changing the plurality of system parameters for a historical review of the customer order.

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