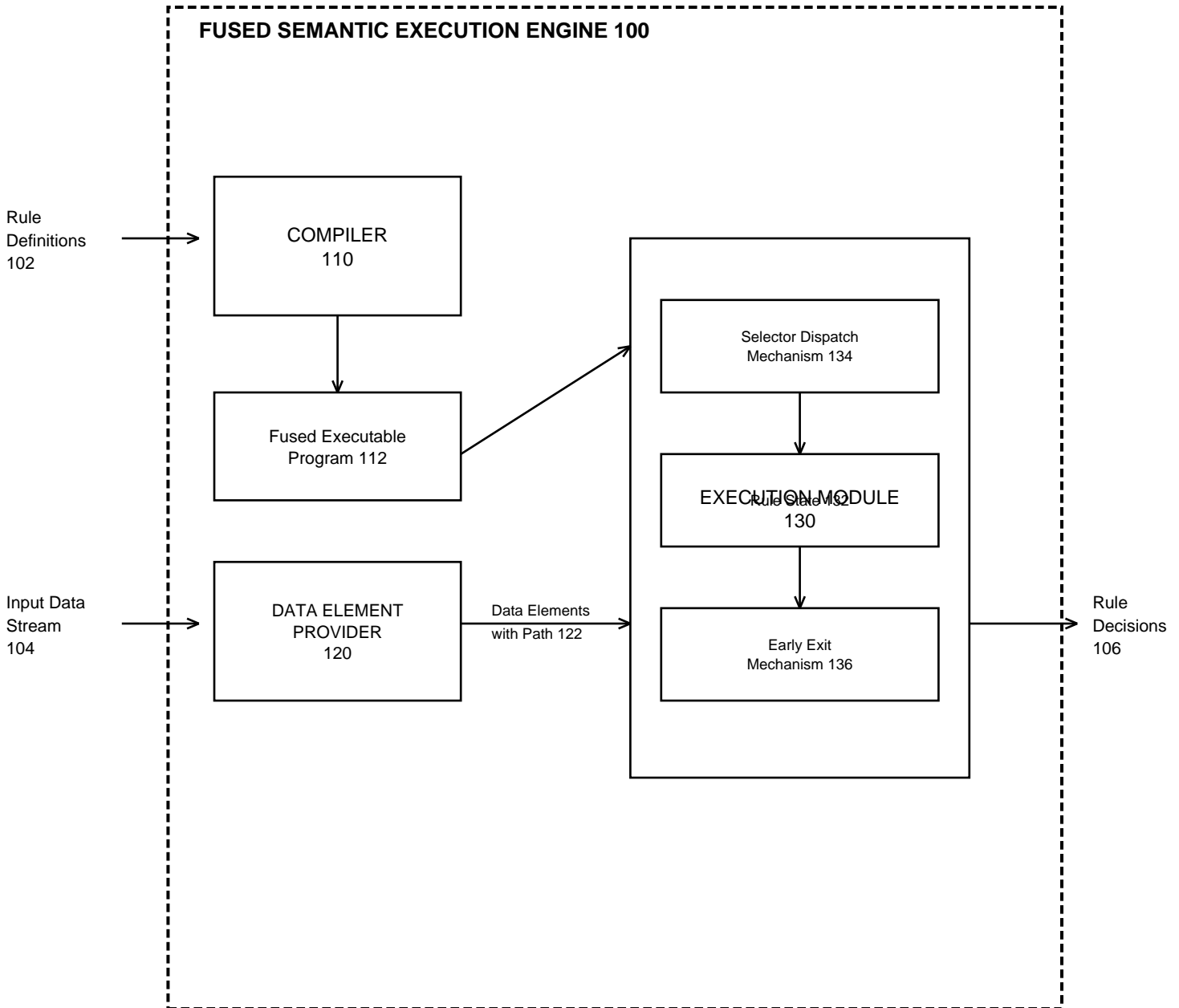
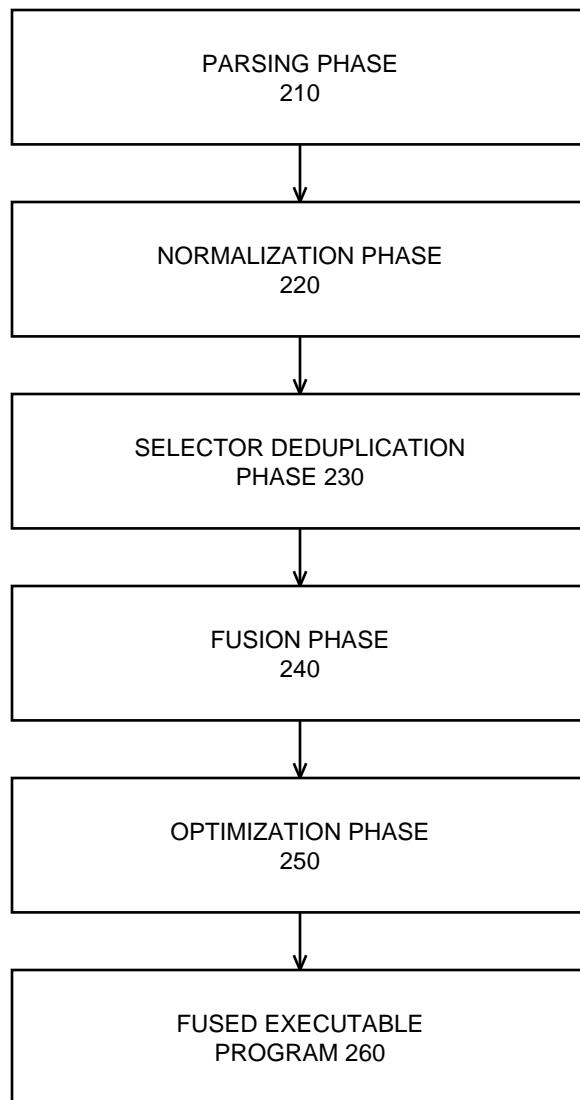


FIG. 1



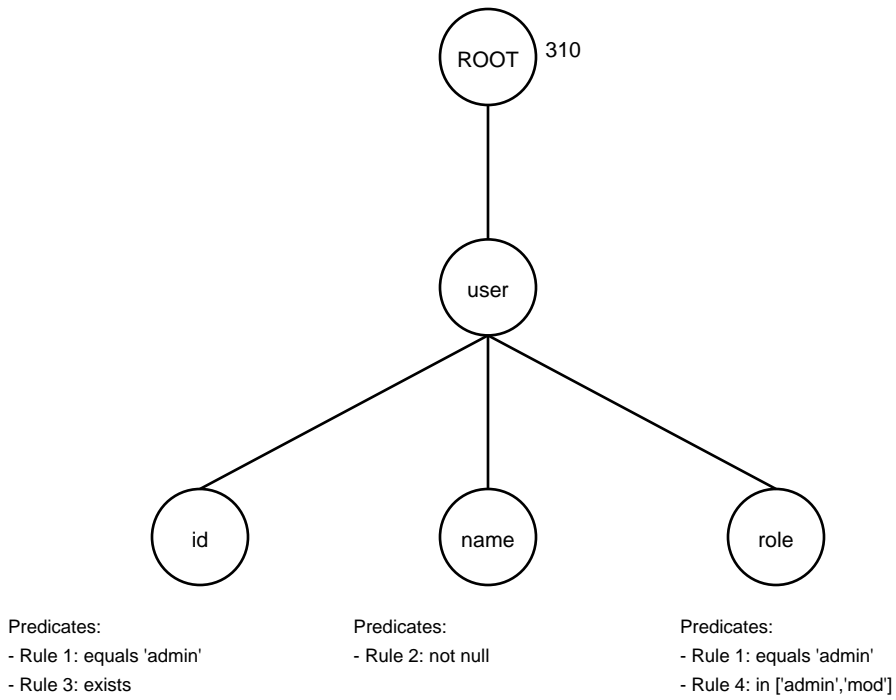
## FIG. 2

### COMPILATION PROCESS 200



**FIG. 3**

SELECTOR PREFIX TREE (TRIE) 300



Legend:

- Nodes represent path prefixes
- Edges represent path components (keys)
- Predicates listed at nodes where evaluation occurs

## FIG. 4

### BYTECODE INSTRUCTION FORMAT 400

#### INSTRUCTION FORMAT:

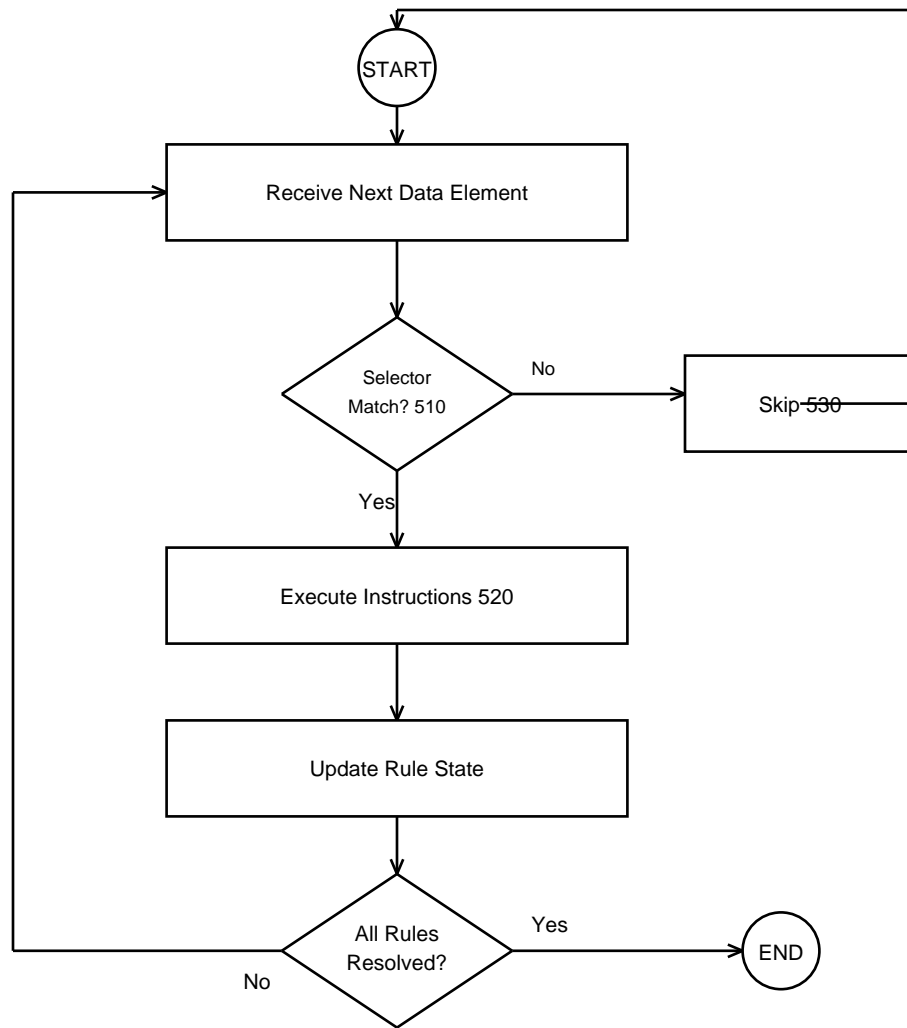
OPCODE (1 byte)	OPERAND 1 (variable)	OPERAND 2 (variable)
--------------------	-------------------------	-------------------------

#### INSTRUCTION SET:

<b>MATCH_PATH</b>	Compare path, branch on result
<b>CHECK_EXISTS</b>	Set rule based on value existence
<b>CHECK_EQ</b>	Compare value to constant
<b>CHECK_LT/GT/LE/GE</b>	Numeric comparisons
<b>CHECK_TYPE</b>	Verify value type
<b>SET_RULE_TRUE</b>	Mark rule resolved true
<b>SET_RULE_FALSE</b>	Mark rule resolved false
<b>EARLY_EXIT</b>	Check if all rules resolved
<b>HALT</b>	Terminate evaluation

**FIG. 5**

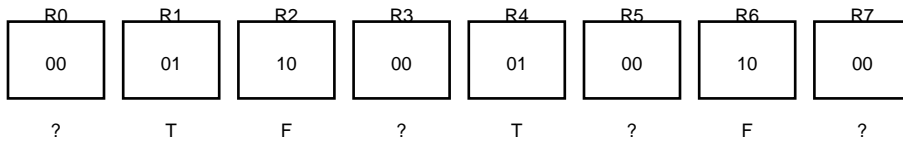
STREAMING EVALUATION PROCESS 500



# FIG. 6

## RULE STATE DATA STRUCTURE 600

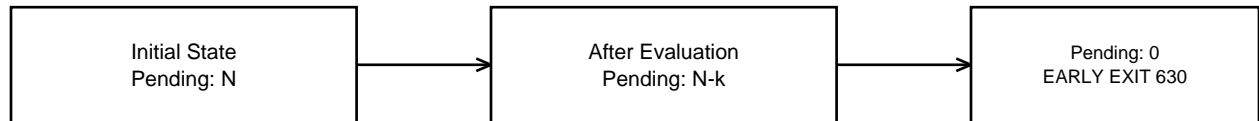
### RULE STATE BITMAP 610



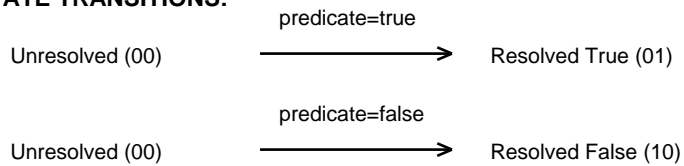
Encoding: 00 = Unresolved (?), 01 = Resolved True (T), 10 = Resolved False (F)

### EARLY EXIT MECHANISM 620

Pending Counter: Decrements as rules resolve



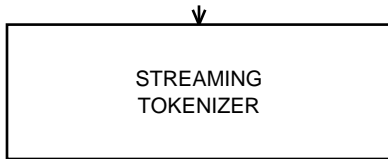
### STATE TRANSITIONS:



# FIG. 7

## DATA ELEMENT PROVIDER INTEGRATION

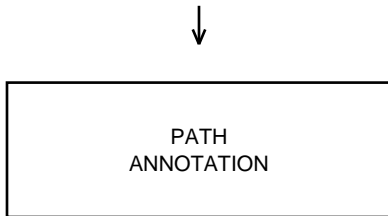
Input: {"user":{"id":"admin"}}



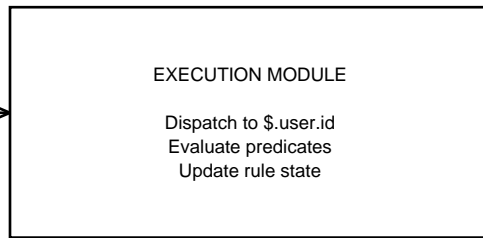
START\_OBJECT depth=0  
KEY 'user' depth=1  
START\_OBJECT depth=1  
KEY 'id' depth=2  
VALUE 'admin' depth=2  
END\_OBJECT depth=1  
END\_OBJECT depth=0

### ZERO-COPY SEMANTICS:

- Values reference input buffer directly
- No memory allocation during evaluation
- Bounded memory determined at compile time



Element: \$.user.id = 'admin'  
Path: ['user', 'id']  
Type: VALUE  
Depth: 2



**FIG. 8**

CONVENTIONAL VS FUSED EVALUATION COMPARISON

**CONVENTIONAL (Rule-First)**  
 **$O(N \times M)$**

Rule 1: Parse → Extract → Eval

Rule 2: Parse → Extract → Eval

Rule 3: Parse → Extract → Eval

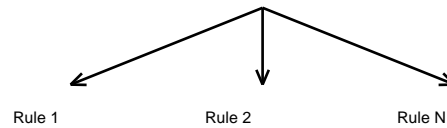
Rule N: Parse → Extract → Eval

- N full data traversals
- Redundant parsing per rule
- Memory: intermediate representations
- No early exit capability

**FUSED (Selector-First)**  
 **$O(M)$**

SINGLE PASS  
Selector dispatch → Value broadcast  
→ Evaluate all predicates  
→ Update all rule states

Value at \$.user.id extracted ONCE



- 1 data traversal total
- Deduplicated selectors
- Memory: bounded at compile time
- Early exit when resolved