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Development of Candidate Symbols for Automobile Functions

Myong Chong
Todd Clauer
Paul Green

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16. Abstract

Suggestions for symbols for various automobile functions were obtained from 25 American drivers. Those functions were airbag, daytime running lamp (on/off), turbo charge, all-wheel drive, all-wheel steer, traction control, and cruise control (on/off, set, resume, coast, accelerate, and decelerate).

Specifically, those drivers were given a 6-page survey that asked them to draw a picture representing each function. From those data three to six candidate symbols were developed for each function. Suggestions for the airbag generally showed an inflated bag and a side view of a seated human figure. For daytime running lamp, suggestions included the sun, either the ISO headlamp symbol, or a front or side view of a car. For all-wheel steer, a plan view of all four wheels (turned) was common. Drawings for all-wheel drive were quite similar, with the digit four being added and the wheels shown straight. Traction control suggestions included views of tires (often end views), various skid marks, and side views of cars in the rain. For turbo charge, cars with arrows indicating acceleration were common. There were no drawings of the turbo charger itself. Finally, for cruise functions, simplified speedometers and foot pedals served as the basis for themes.

In subsequent research, testing of the understandability and legibility of those candidates on a world-wide basis is recommended.

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INTRODUCTION

Associated with the growth in the number of functions available on contemporary cars and trucks, is a need to communicate to drivers how to control those functions and display information about them. To promote world-wide sales of common vehicles and facilitate international travel, symbols have been advocated as a communication medium. Accordingly, standard international symbols have been and are continuing to be developed (International Standards Organization, 1982).

Recently, International Standards Organization (ISO) Technical Committee 22, Subcommittee 13 (Ergonomics of Road Vehicles), has requested ideas for symbols for the following automobile functions: airbag, daytime running lamp (on/off), turbo charge, all-wheel drive, all-wheel steer, traction control, and cruise control (on/off, set, resume, coast, accelerate, and decelerate) (International Standards Organization, 1990). That request was in turn passed along by the U.S. Technical Advisory Group to the authors and led to the research described here. The research was conducted by the first two authors as a student research project, under the direction of the third author. Testing of driver understanding of the alternatives was not requested.

As in earlier studies conducted at The University of Michigan Transportation Research Institute (Green, 1979, 1981, Gingold, Shteingart, and Green, 1981, Sayer and Green, 1988, Eberhard and Green, 1989), the "population-stereotype production technique" was used to gather drivers' suggestions for standard symbols. This method has been shown to more likely lead to the development of well understood symbols than when symbols were developed ad hoc (Karsh and Mudd, 1961; Mudd and Karsh, 1962). In that technique, a description of the function (e.g., trunk release) is provided and participants draw pictures to represent that function. Because the participants are usually not artists, the drawings tend to be crude.

In some sense, identification of the method as the "population stereotype production technique" is a misnomer. As normally thought of in a human factors context, population stereotypes represent user expectations and the most commonly identified expectation is the preferred design. For example, in the case of control-display compatibility, most people expect a toggle switch to move up (except in the U.K.) to turn something on, and switches should normally operate that way (Loveless, 1962). However, in the case of symbols, people are limited by their artistic skills and hence what they draw should be viewed as a pool of ideas. The image depicted most frequently is often not the best idea.

It is important, however, that those ideas be obtained from people similar to the intended users. For example, when asked to draw symbols to represent the transmission, engineers draw pictures of gears while ordinary drivers draw shift levers. Likewise, for braking functions, engineers draw brake shoes while ordinary drivers depict brake pedals. Thus, engineers often depict the internal workings of a system while typical drivers show what they can see.

TEST PLAN

TEST EQUIPMENT AND MATERIALS

The authors developed a six-page survey using the "population stereotype production technique." The first page was used to record biographical data (name, age, sex, years of driving experience) and the participants' experience with the automobile functions for which symbols were being developed. The next page gave a brief summary of the purpose of the experiment along with detailed directions. The directions stressed that words should not be used in the drawings. The instruction page also presented examples of four international symbols. On the remaining pages appeared the symbol names (three to a page), one- or two-sentence descriptions, and 1-1/2 inch square boxes in which to draw candidate symbols. Participants were given a black broad tip magic marker with the survey. The small boxes and broad markers kept the amount of detail shown from being beyond that which could be shown in an ISO symbol.

Three University of Michigan Transportation Research Institute (UMTRI) employees responded to the first draft of the survey. This pilot test examined if the directions and the descriptions of the functions were clear and if the survey could be completed in a reasonable amount of time. The subjects were videotaped and asked to think out loud (Lewis, 1989).

These data led to revisions in the order in which the symbols were listed in the survey. It was clear that the most difficult functions had to be last so that early "successes" would encourage participants to try to develop symbols for the more abstract functions and complete the survey. Therefore, cruise control functions were moved to the end Also, to get participants to think of the cruise controls as a set, instructions were added to encourage review of all cruise features before drawing any. This reduced the number of revisions participants made. In addition, a comment was added not to show where switches might be located.

TEST PARTICIPANTS

Twenty-five licensed drivers (10 women,15 men) participated. They were acquaintances of the authors, except for people over 60 who were members of a local investment club. Participants ranged in age from 16 to 66 years old (mean=41). Their driving experience ranged from 0.5 to 49 years (mean=25). Twenty-one drivers indicated that they had driven in another country (probably Canada in most cases since it is only an hour away). Occupations represented in the sample included high school students, college professors, researchers in a biochemistry lab, artists, civil engineers, and retired engineers of various types. Twelve participants completed graduate school, 6 completed college, 5 completed high school, and 2 had not completed high school.

TEST ACTIVITIES AND THEIR SEQUENCE

Participants were approached individually by the first two authors. Surveys were completed in locations that were convenient. For the investment club members, the survey was completed in their homes. For the acquaintances the surveys were completed in a research laboratory, in an office, on a soccer field, and at UMTRI. During the survey the authors remained close by to assist the participants in any possible way. Since, many of the participants were approached at work, supervision was not always continuous. The survey was completed in 20 to 30 minutes.

RESULTS

Approximately five incomplete surveys were returned. Most of the missing data were in the cruise control section. One other incomplete survey was returned without a drawing for turbo charge. A few people drew the location for a button. In some cases this occurred because the experimenters did not do enough to encourage participants to complete survey items and not to use any words. In most incomplete surveys the participants were just not able to come up with any ideas. Nevertheless, many interesting ideas were gathered. (See Appendix B.)

For the airbag, balloons seemed to be the most popular idea, a drawing of an airbag coming out of the steering wheel with the driver was also a prominent drawing. A few suggestions were made with slashes through an airbag. For candidate symbols emerging from these ideas, refer to Figure 1.

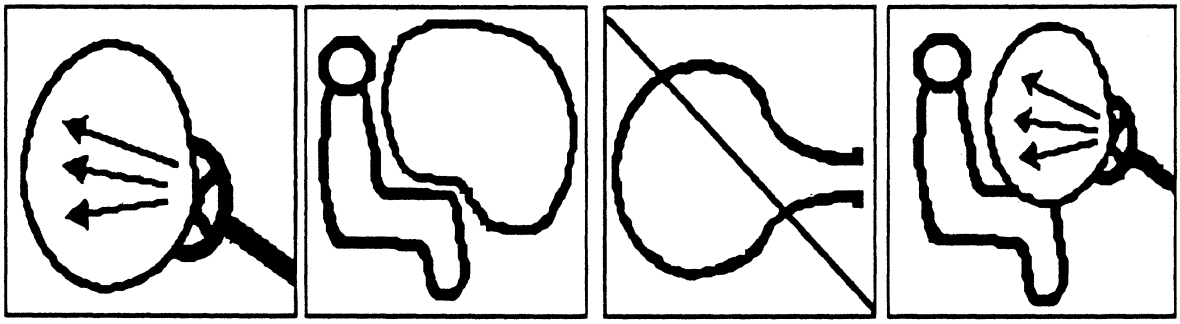

Figure 1. Candidate Symbols for the Airbag Based on Driver Input

The ISO symbol for light and a side or a front view of a car with the headlights on were the popular ideas for the daytime running lamp. Most of the drawings also included pictures of the sun to indicate daytime. A unique idea of a car driving into the horizon was also suggested. Candidate symbols are shown in Figure 2.

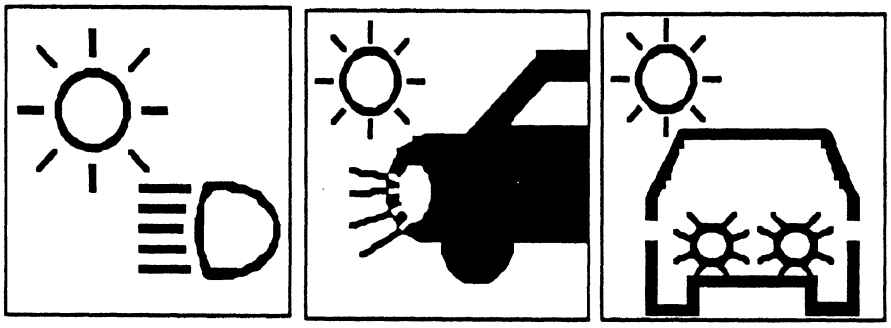

Figure 2. Candidate Symbols for Daytime Running Lamp Based on Driver Input

For turbo charge, a car with a bold arrow pointing in one direction indicating rapid acceleration seemed to be the most common suggestion. Some other interesting ideas were a checkered flag and a drawing of an explosion. In addition, several people drew jet engines. Figure 3 shows suggested symbols for this function.

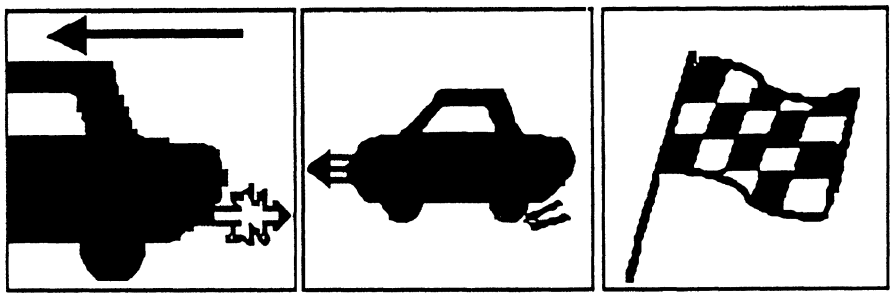

Figure 3. Candidate Symbols for Turbo Charge Based on Driver Input

Many suggestions for the all-wheel drive/four-wheel drive (on/off) were given. Views of a car (from the top, side, or under) with four wheels showing or four tires with the number four visible were most common. In addition, just four tires with the number four were suggested. Several drawings included gear boxes. Suggestions appear in Figure 4.

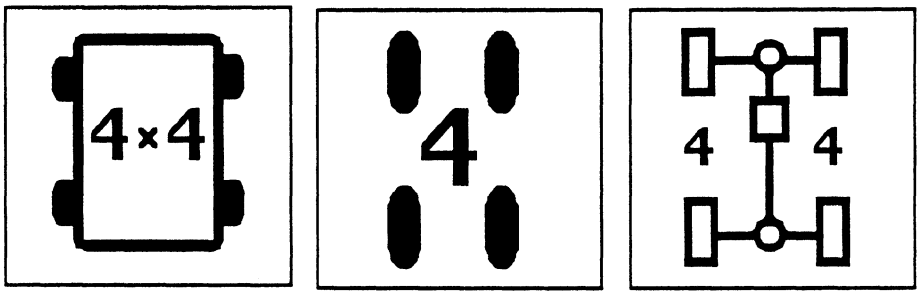

Figure 4. Candidate Symbols for Four-Wheel Drive Based on Driver Input

Suggestions for all-wheel steer varied widely. Four tires with a steering wheel, various views of a car (from the top, side, or under) with all four wheels turned and the steering wheel present were drawn frequently, as shown in Figure 5.

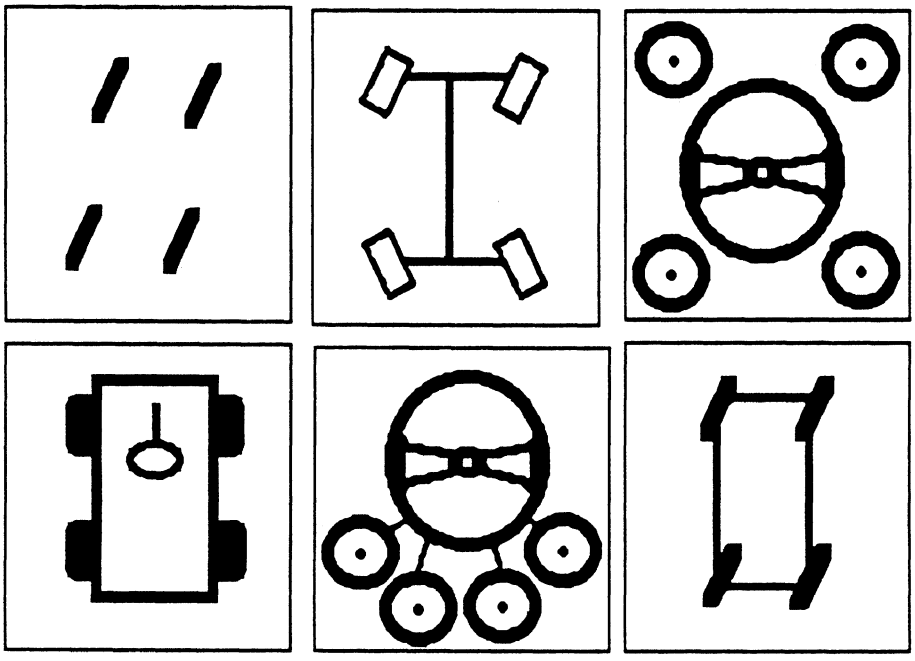

Figure 5. Candidate Symbols for All-Wheel Steer Based on Driver Input

For traction control, a tire, skid marks (wiggly lines), and pictures of a tire with skid marks were popular suggestions. Another idea was a drawing with rain or ice with a car driving through a puddle. Possible candidates are shown in Figure 6.

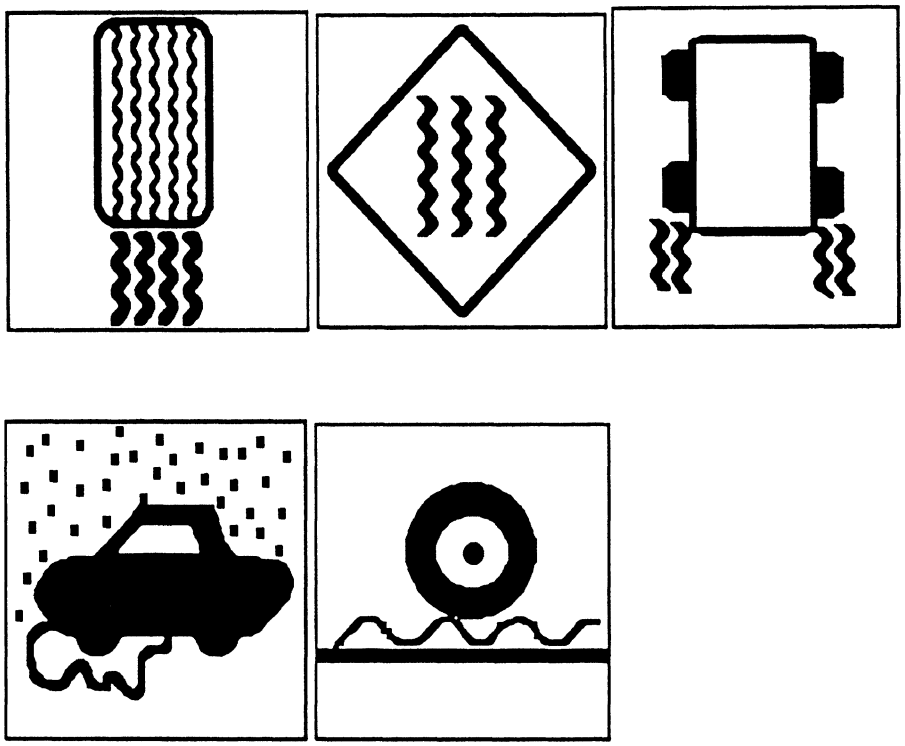

Figure 6. Candidate Symbols for Traction Control Based on Driver Input

For the six cruise control functions, several basic themes emerged--speedometers with arrows implying the actions of the car, drawings of feet and the accelerator, and cars with arrows to indicate actions. The modifier chosen (for on/off, coast, etc.) depended upon the cruise theme chosen (speedometer, foot pedals, etc.) and it was difficult for participants to think of appropriate images for the modifiers.

The on/off feature was represented many different ways, with no single idea being represented more than twice in the sample. Some of the ideas included plus and minus sign pairs, placing a slash through the symbol, and using an arrow to point to a foot, display or the accelerator. Another unusual idea was V=k, for velocity equals constant.

For the set function, there was some tendency for participants to emphasize a fixed value, either by showing a number (55 or 60) or by having an arrow pointing to one. In the case of the foot pedal design, participants either showed the foot being lifted off the accelerator or adjacent to it, or their feet tucked in--what drivers do when the cruise control is set. A few other ideas were a thumbs up sign and a single V for velocity.

The most prominent idea for resume were arrows showing the speedometer or the accelerator moving back towards a specific location. Two other ideas were a curved lined becoming straight and an arrow going around in a circular motion.

The coast function was probably the most difficult of all the drawings. A foot being raised from the accelerator and the speedometer going to zero were drawn several times. A few participants drew arrows slanting from the upper left to the lower right, possibly suggesting coasting down a hill.

Arrows indicating increased motion was the nearly unanimous choice for acceleration. The arrows were drawn alone, with speedometers, with accelerator pedals, and with cars. One participant drew two numbers with the arrow pointing from the smaller to the larger value.

Deceleration was almost the exact opposite. This function was presented directly after acceleration and, with almost no variation, the participants simply reversed their previous drawings by turning acceleration arrows in the opposite direction.

Figure 7 shows the suggestions for on/off (a) set (b) resume (c) coast (d) accelerate (e) and decelerate (f).

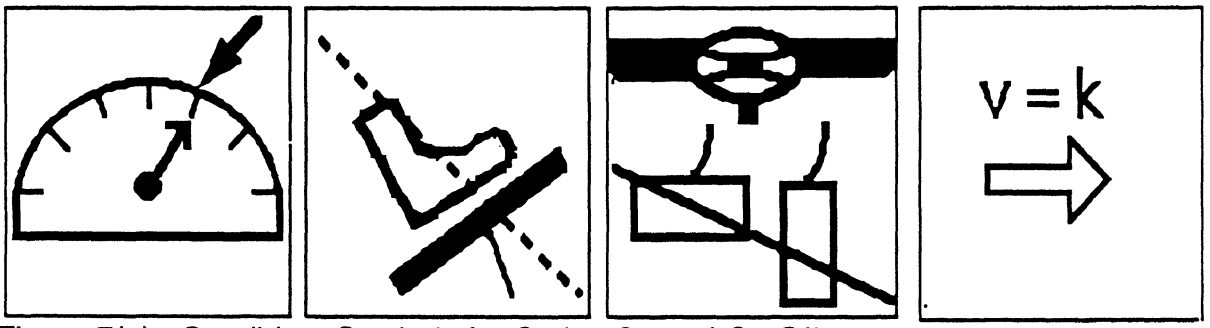

Figure 7(a). Candidate Symbols for Cruise Control On/Off

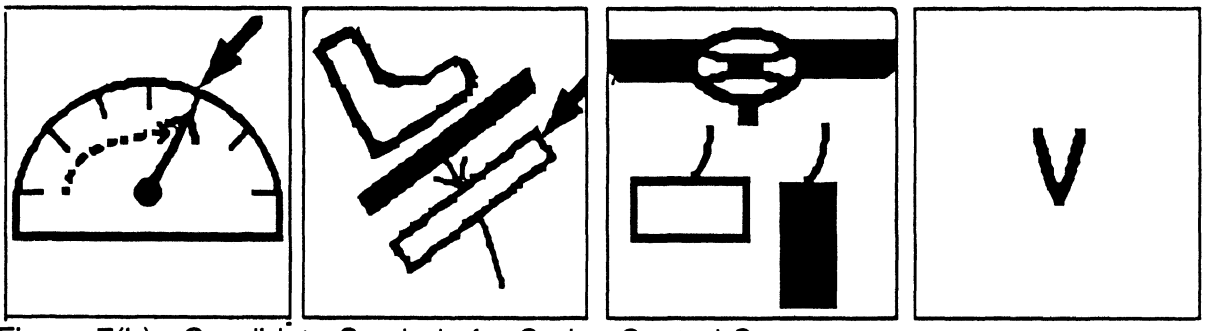

Figure 7(b). Candidate Symbols for Cruise Control Set

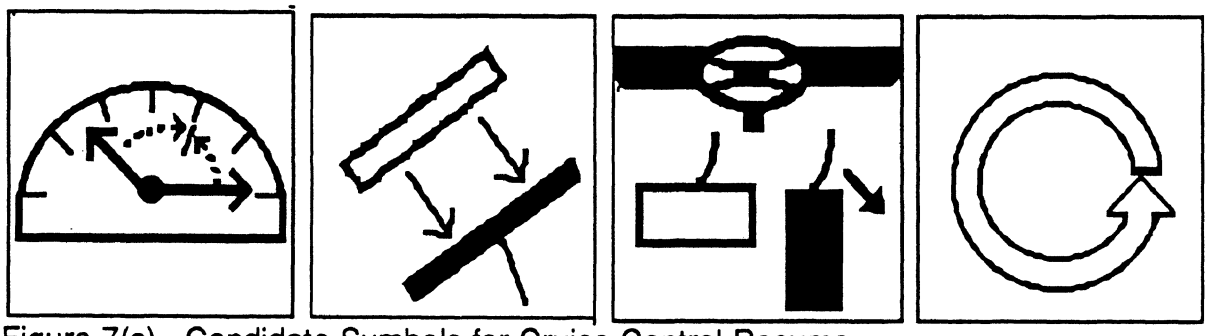

Figure 7(c). Candidate Symbols for Cruise Control Resume

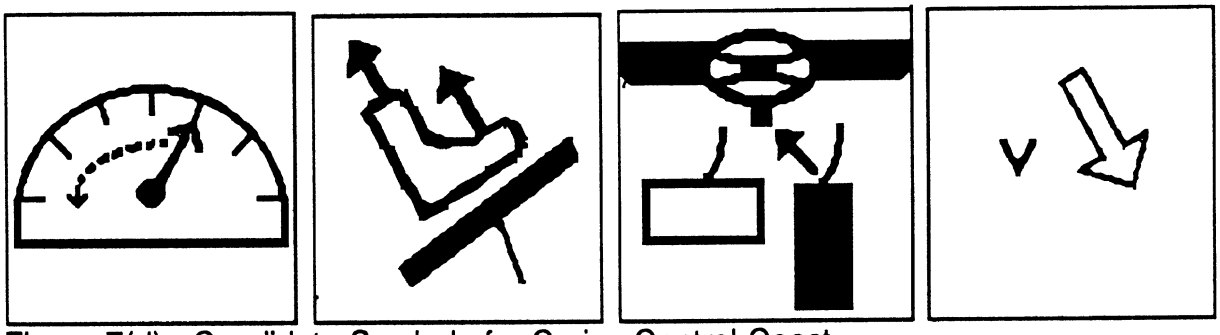

Figure 7(d). Candidate Symbols for Cruise Control Coast

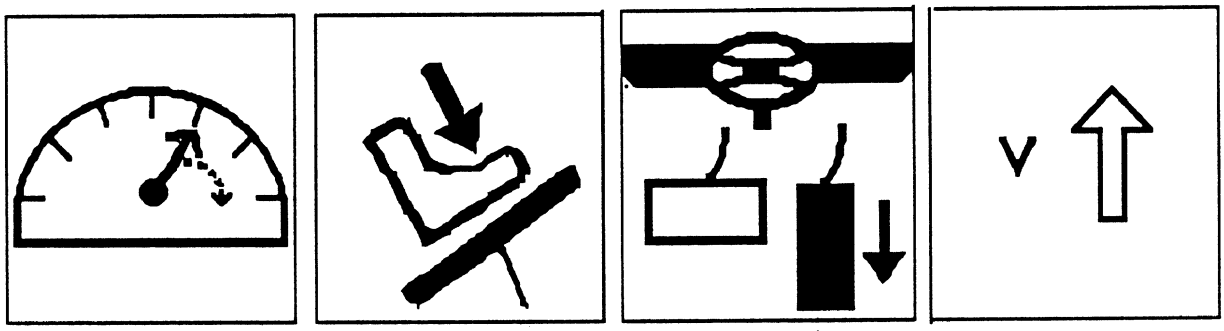

Figure 7(e). Candidate Symbols for Cruise Control Accelerate

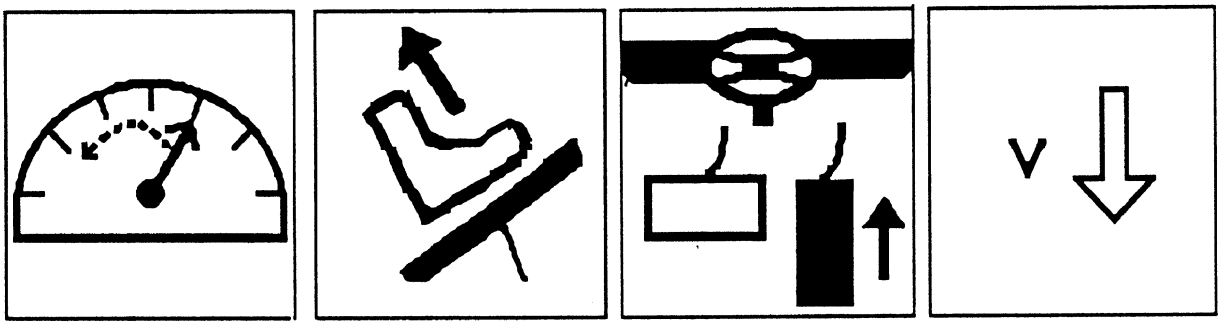

Figure 7 (f). Candidate Symbols for Cruise Control Decelerate

Although participants were familiar with most of the functions examined, some were completely unfamiliar. For example, all participants except one, had driven an automobile with cruise control, but none had driven in an automobile with daytime running lamp. Surprisingly, even though the participants had not used the functions, they were able to draw symbols for the unfamiliar functions (daytime running lamps, airbag) more easily than the most familiar function (cruise control).

RECOMMENDATIONS AND CONCLUSIONS

The symbol production task identified many useful and interesting ideas for symbols, ideas the authors alone might not have generated. However, some of the surveys were returned incomplete and others contained words or letters (unusable data). Had the experimenters remained with the participant, this probably would not have occurred.

The candidate symbols suggested by this study are in need of fine tuning to improve their clarity and aesthetic appeal. Furthermore, additional thought needs to be given to the cruise control symbols as none of the candidates offered are likely to be well understood. Also, there are apt to be other symbol designs not suggested by the participants in this study. (For example, no participant drew a picture of an ocean liner (cruise ship) for a cruise control function.) Subsequently, the candidate symbols presented here, in conjunction with symbols developed by other contributors to ISO TC 22/SC 13/WG 5, should be tested in terms of their legibility, discriminability, and recognition on a world-wide basis.

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APPENDIX A - SURVEY

The following survey instructed drivers to draw candidate symbols for the airbag, daytime running lamp (on/off), turbo charge, all-wheel drive, all-wheel steer, traction control, and cruise control (on/off, set, resume, coast, accelerate, and decelerate) functions.

Subject #__
Date _____
Exp. _____

Biographical Data Sheet for
Symbols of Automobile Functions

Myong Chong
Todd Clauer
Paul Green

1. Name: _____

2. Sex: _____

3. Age : _____

4. How many years have you driven an automobile? (yrs) _____

5. Educational experience: (circle the highest level completed)
   less than high school
   high school
   trade school
   college
   post-college

6. Are you a licensed driver? yes _____ no_____

7. Have you ever driven an automobile with the following functions: (If you do not know what the function is, please answer no.)
   a. Airbag: yes_____ no_____
   b. All wheel drive/Four wheel drive: yes_____ no_____
   c. All wheel steer/Four wheel steering: yes_____ no_____
   d. Cruise control: yes_____ no_____
   e. Daytime running lamp: yes_____ no_____
   f. Traction control: yes_____ no_____
   g. Turbo charge indicator: yes_____ no_____

8. Have you driven in another country? (including Canada)
   yes_____ no_____

The Development and Testing of Symbols for Specific Automobile Functions

Instructions

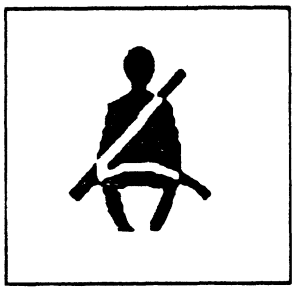
This experiment is concerned with developing symbols for several automobile functions for an international standard. These symbols are going to be used in cars of the future that you might drive, so your input is important. It is very important that each of the symbols be legible and understandable.

On the following pages are written descriptions of different automobile functions. For each individual description you are asked to draw a picture in the given box showing what you think the symbol should look like. *Please try to draw different symbols for each function.* Do not draw a switch or a warning light, just the picture that would be on or next to it. Please keep the drawings simple (avoid detail) and *do not use any words* in the box. Don't worry if your drawings are crude.

Here are four examples:

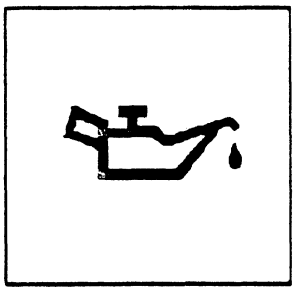
Description: Please Fasten Seat Belt

Symbol:



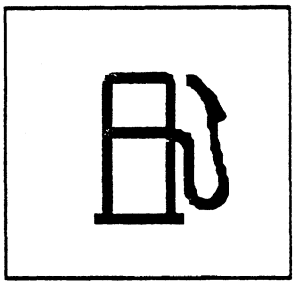
Description: Oil level is low (if light comes on) or a label for oil gauge.

Symbol:



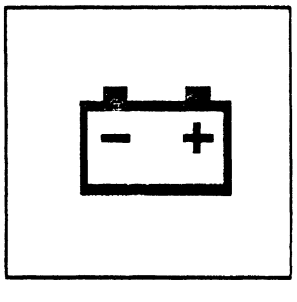
Description: Gas Level is Low (if light comes on) or label for gas gauge.

Symbol:



Description: Battery charge level is low (if light comes on) or label for battery charge level gauge.

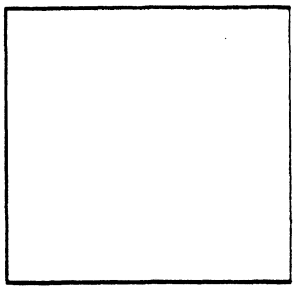
Symbol:



Specific Symbols

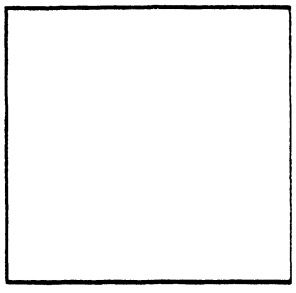
1. Airbag:

This symbol will be next to a light that will go on if the airbag may not work properly.



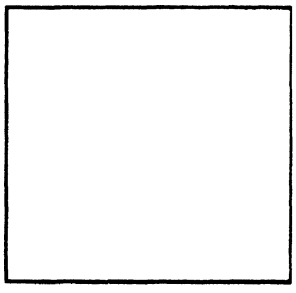
2. Daytime running lamp:
(on/off)

This is a function that is not presently in use in the United States. The purpose of the daytime running lamp is to continually run the headlights at a lower intensity during daylight so that the car can be seen by an oncoming driver.



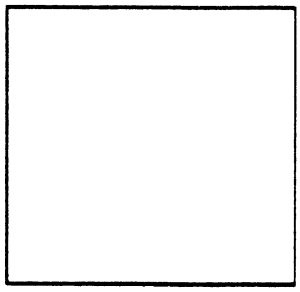
3. Turbo Charge:

A turbo charger on a car automatically boosts the engine power so the car accelerate faster. This symbol should indicate whether the turbo charge is in use or not or as a warning light.



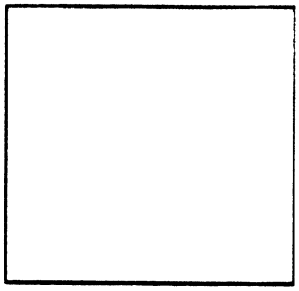
4. All wheel drive/
Four wheel drive: (on/off)

This function connects the engine to all four wheels instead of the front or rear wheels only. It is usually turned on by pressing a button.



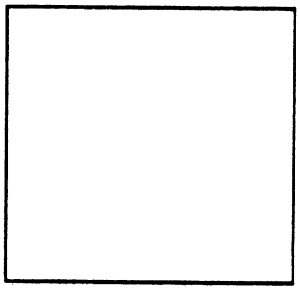
5. All wheel steer:

This function allows the driver to steer all four wheels together instead of only two wheels. It helps to make the car more maneuverable. This is a warning light for a failure or the function or an on/off switch label.



6. Traction control:

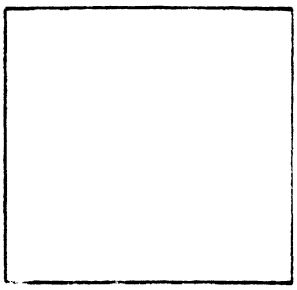
This function works when the wheels of the car encounter a slippery surface. Power is diverted from a wheel that is slipping to a wheel that is stable, giving the driver more control on wet or icy surfaces. This symbol should indicate whether the traction control is in use or not, or as a warning light.



The last two pages of this survey are functions of cruise control. Please read through all six of these descriptions before beginning to draw the symbols.

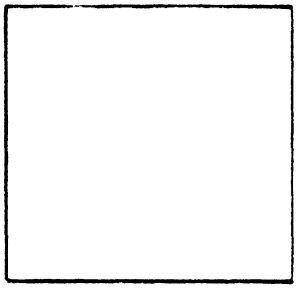
7. Cruise Control: (on/off)

This function allows the driver to operate a car at a constant speed without using the accelerator. This symbol is for the on/off function for the cruise control unit.



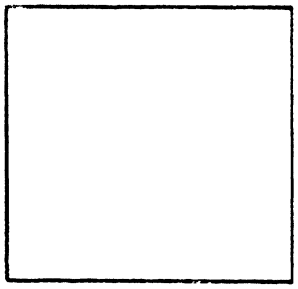
8. Cruise Control: (set)

This function of the cruise control sets the speed at which the driver wants to remain. To use the set function, the driver accelerates to the desired speed and pushes the set button. Then, the driver releases the accelerator and the car continues to go at the set speed.



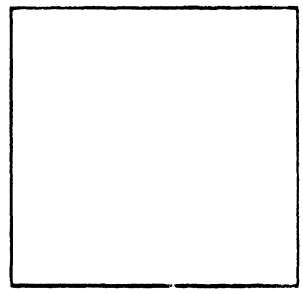
9. Cruise Control: (resume)

This function causes the car to return to the set speed after the driver brakes or stops the car. To use this function, the driver must accelerate to approximately the previously set speed and then press the resume button. The automobile will resume to the previously set speed.



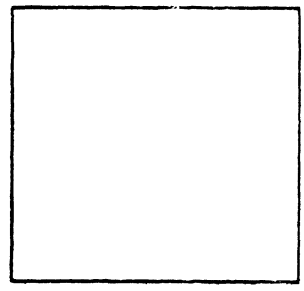
10. Cruise Control: (coast)

This function slows the car without applying the brakes. This function is commonly used when the driver approaches traffic and wishes to gradually slow down. A comparable effect would be when a driver would take their foot off the accelerator in regular driving.



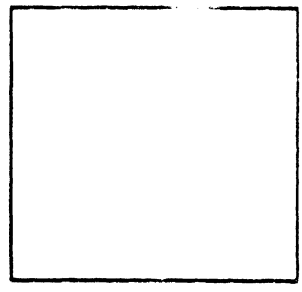
11. Cruise Control: (accelerate)

This function allows the driver to accelerate to a higher speed than the original set speed. The longer the button is held down, the greater the speed setting is increased.



12. Cruise Control: (decelerate)

This function allows the driver to decelerate to a lower speed than the original set speed. The longer the button is held down, the greater the speed setting is decreased.

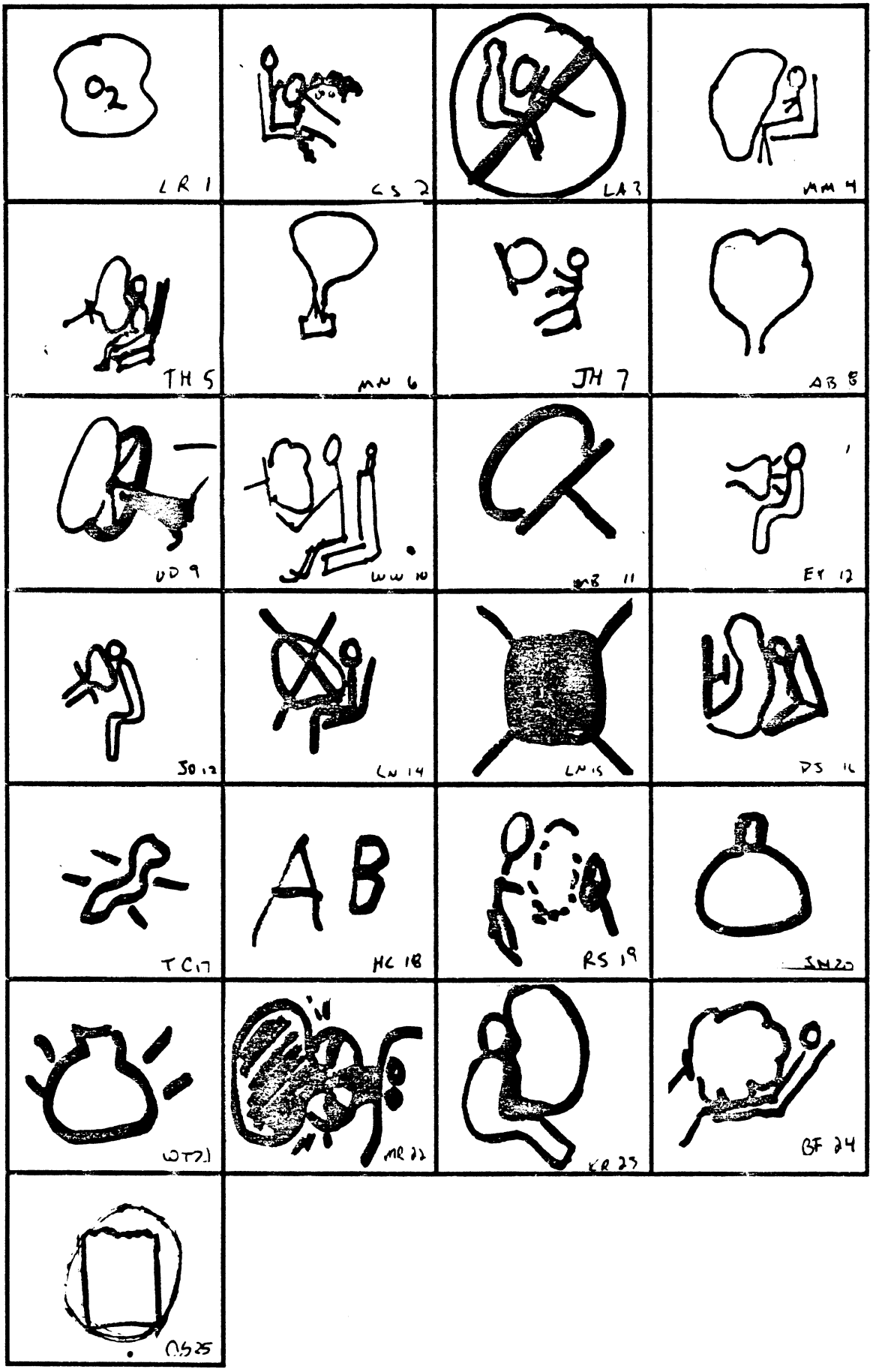


APPENDIX B - PARTICIPANTS' DRAWINGS

The candidate symbols suggested by the 25 participants of this study are shown on the following pages. The symbols are shown according to function, each identified by the subject number and initials in the lower right corner of the symbol.

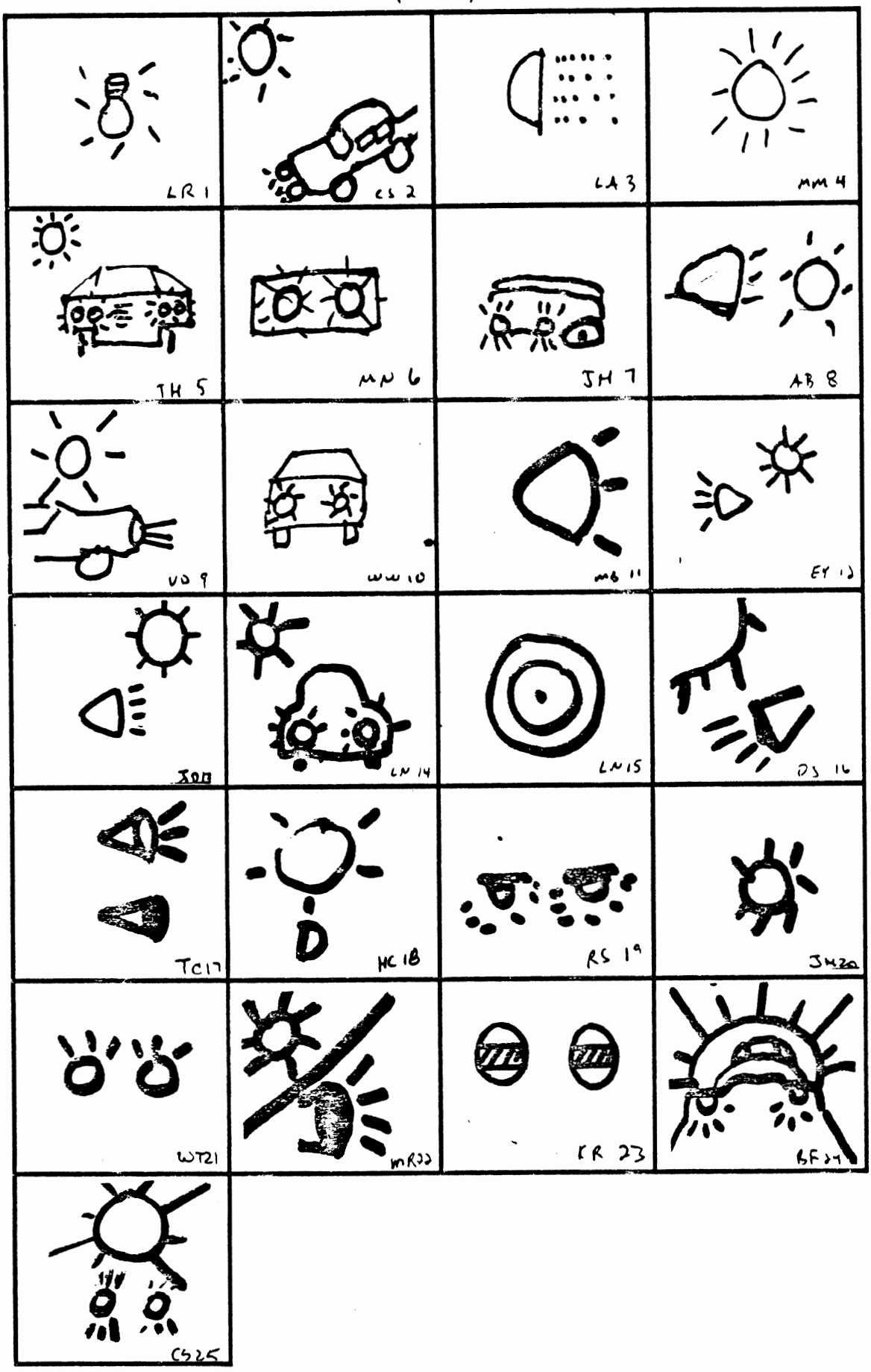
Suggestions for Airbag Symbol

(n = 25)



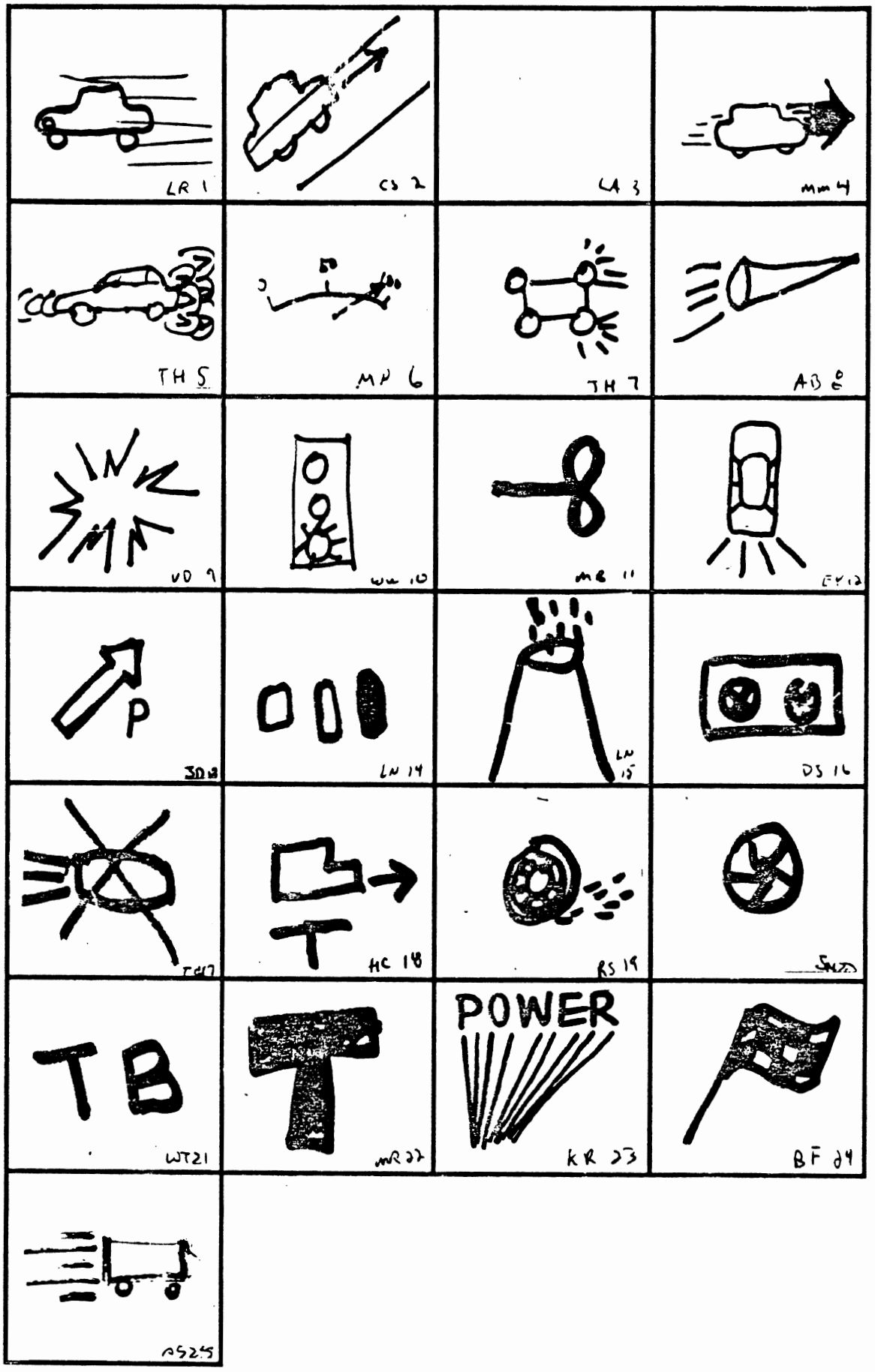
Suggestions for Daytime Running Lamp (On/Off) Symbol

(n = 25)



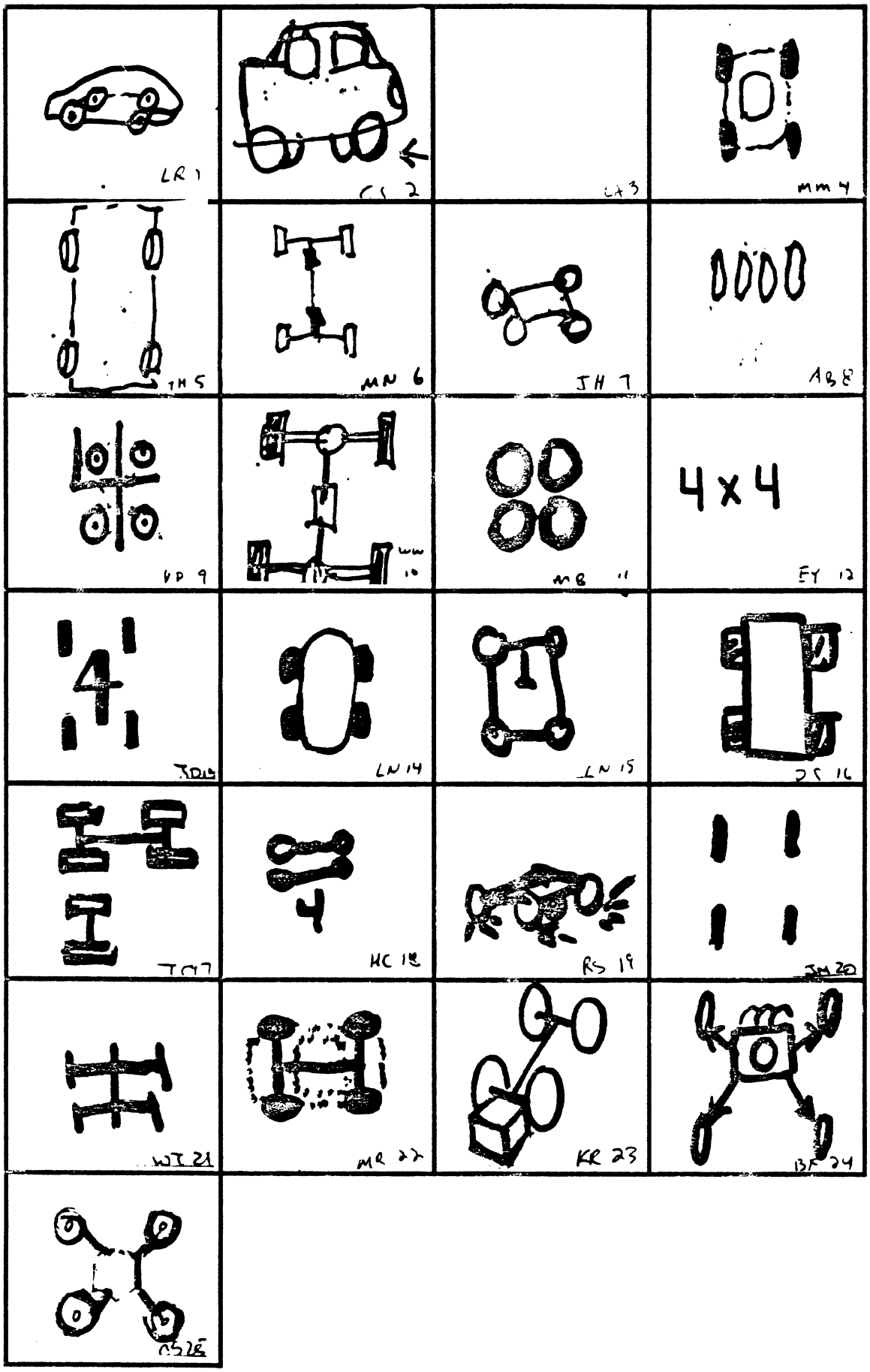
Suggestions for Turbo Charge Symbol

(n = 25)



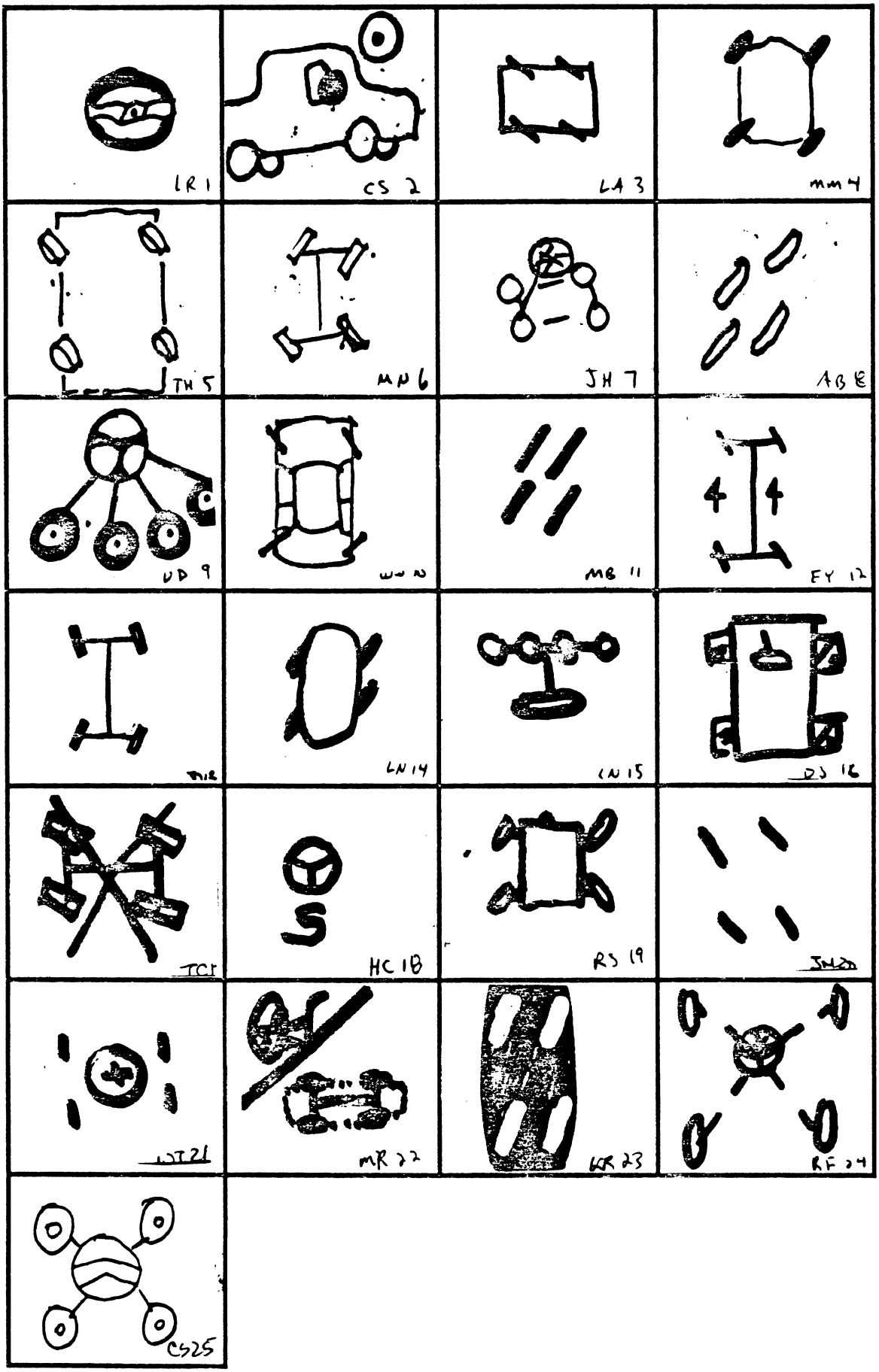
Suggestions for All-Wheel Drive Symbol

(n = 25)



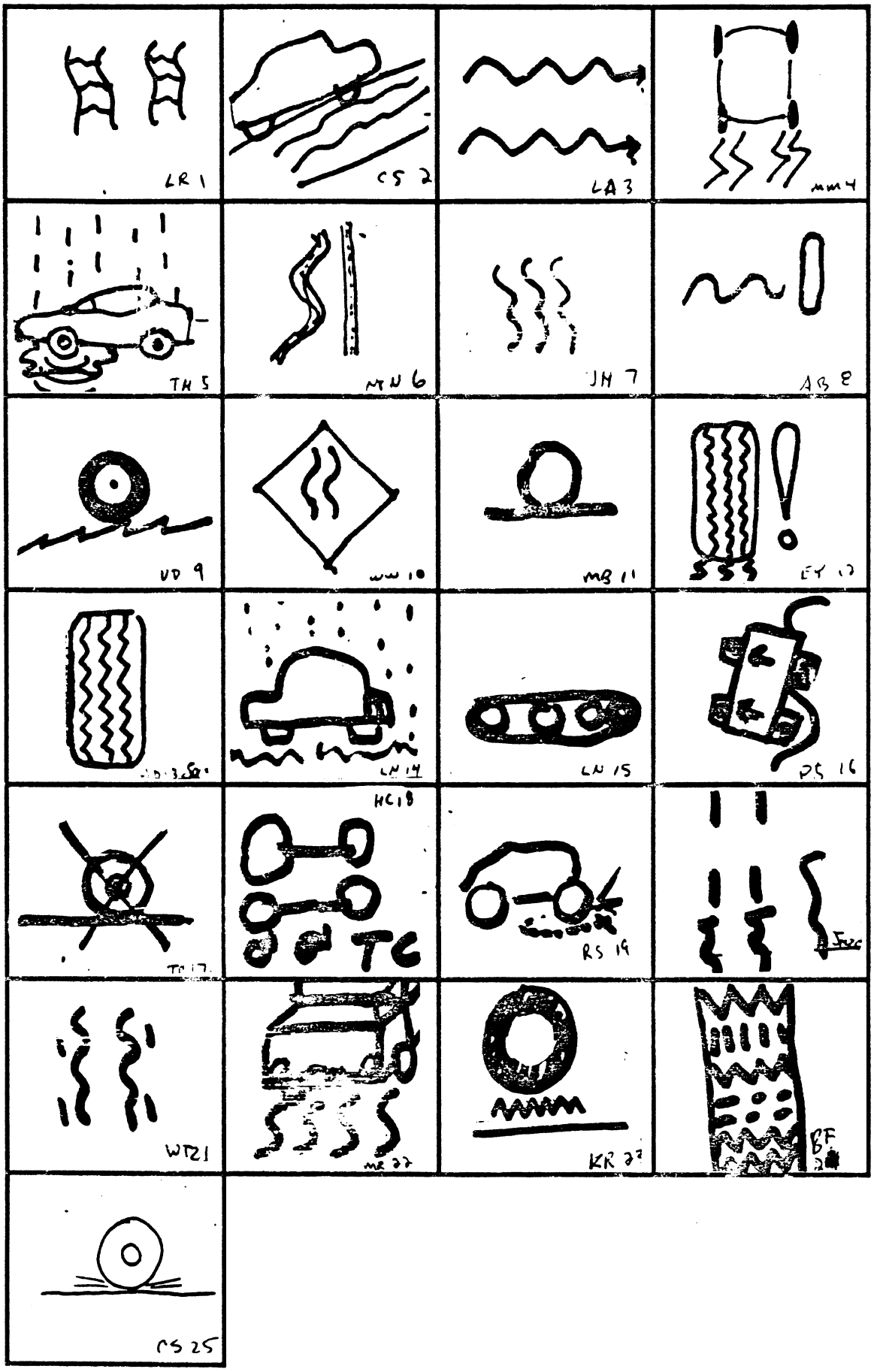
Suggestions for All-Wheel Steer Symbol

(n = 25)



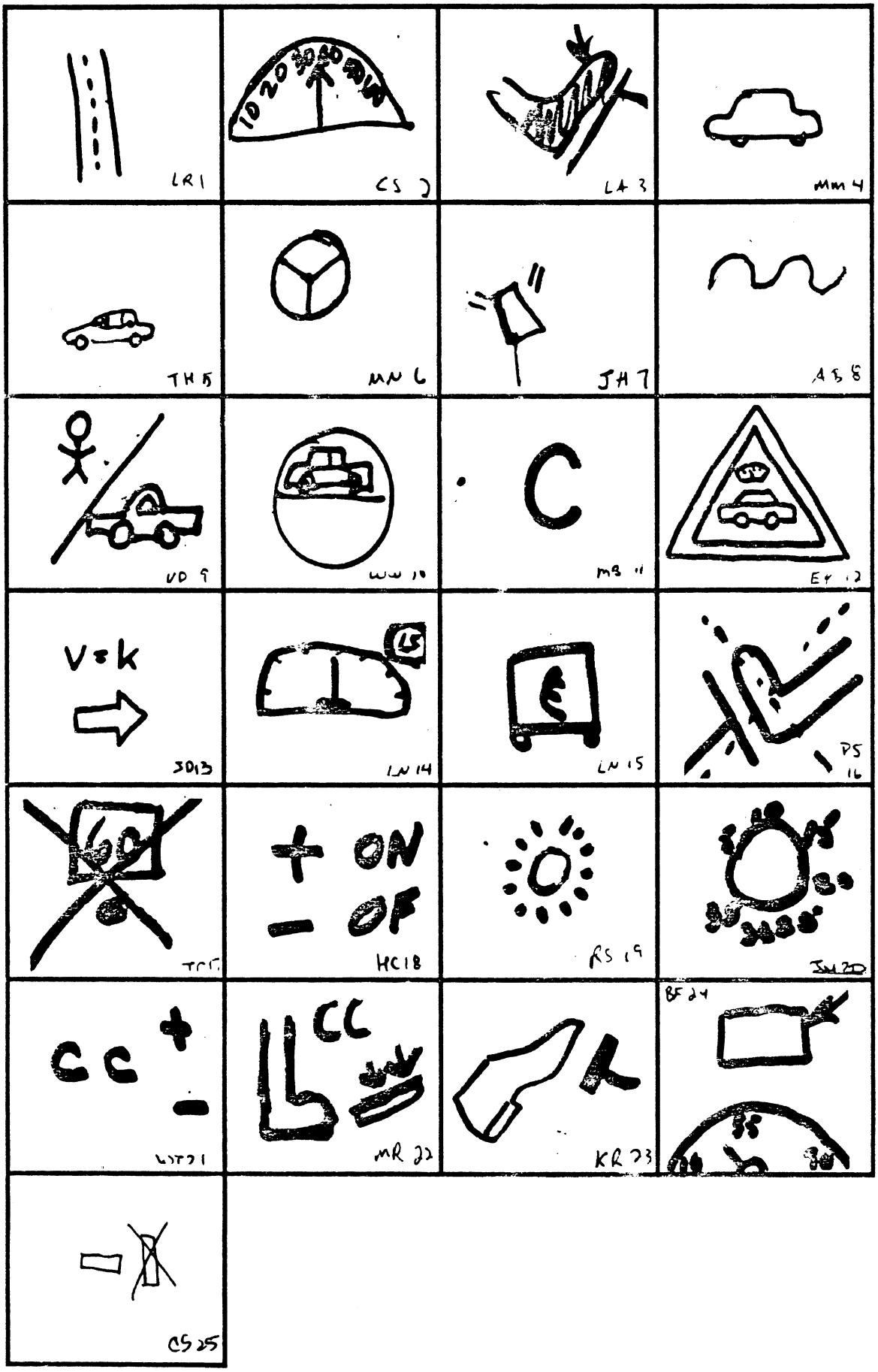
Suggestions for Traction Control Symbol

(n = 25)



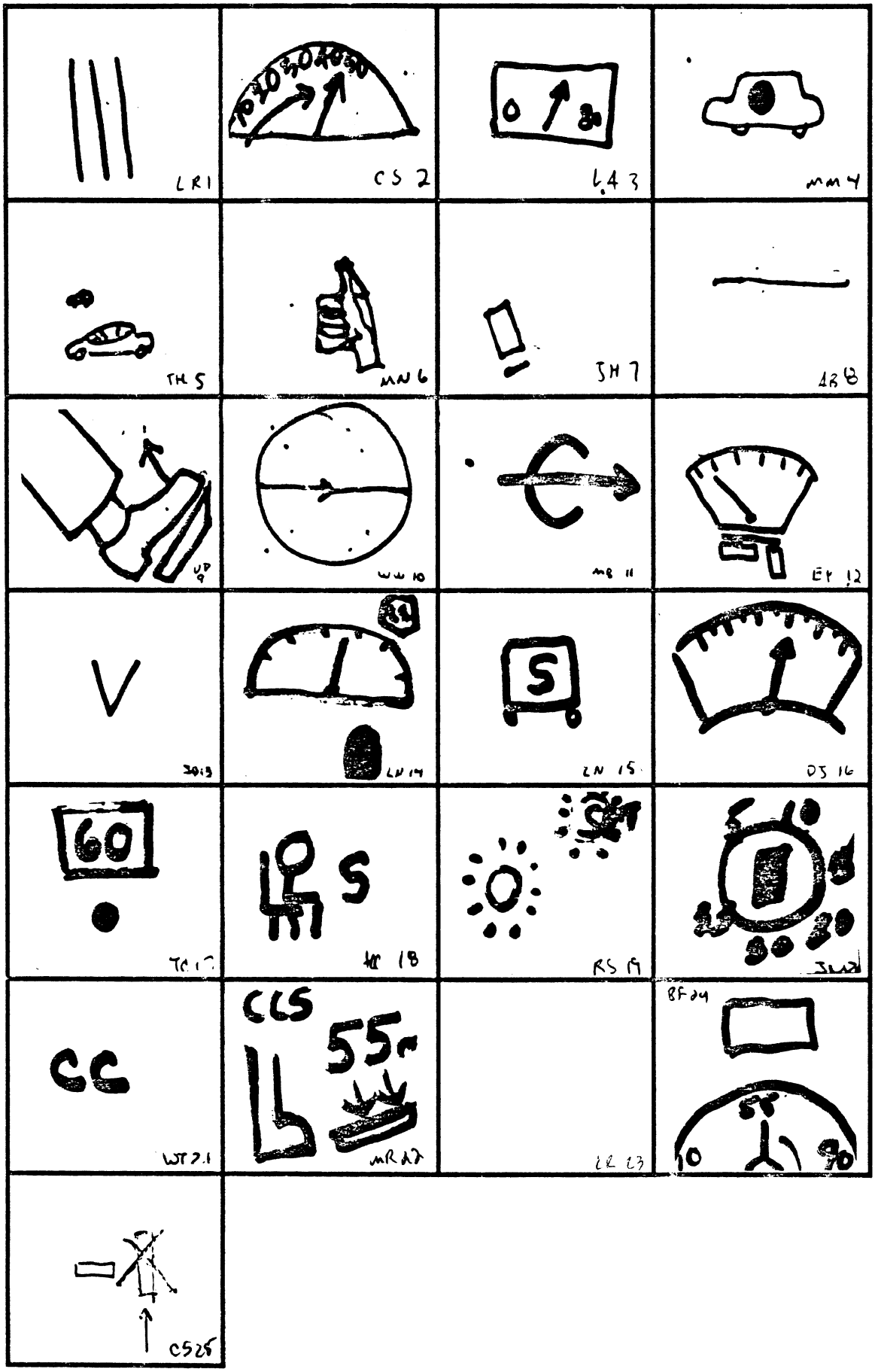
Suggestions for Cruise Control On/Off Symbol

(n = 25)



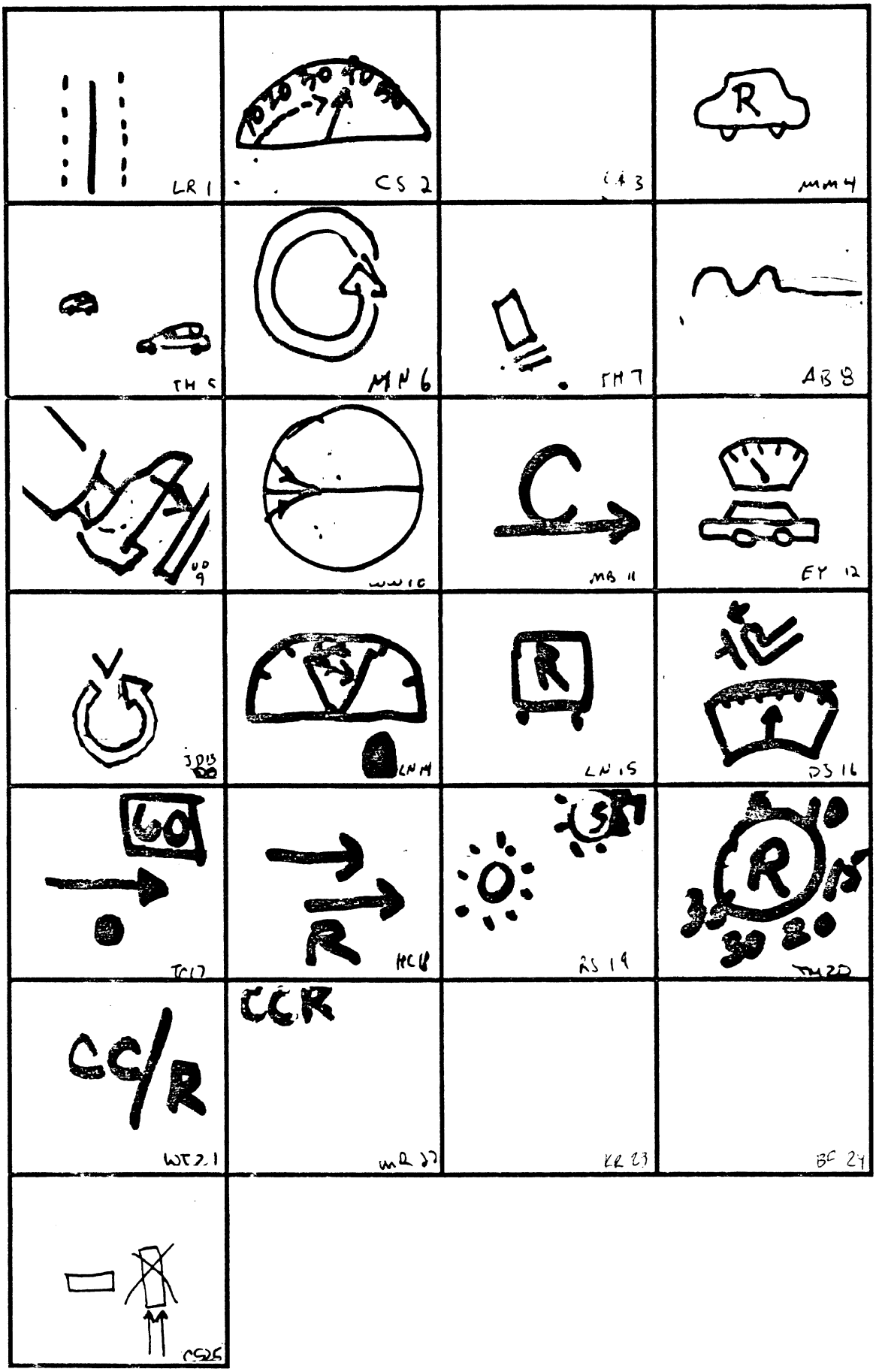
Suggestions for Cruise Control Set Symbol

(n = 25)



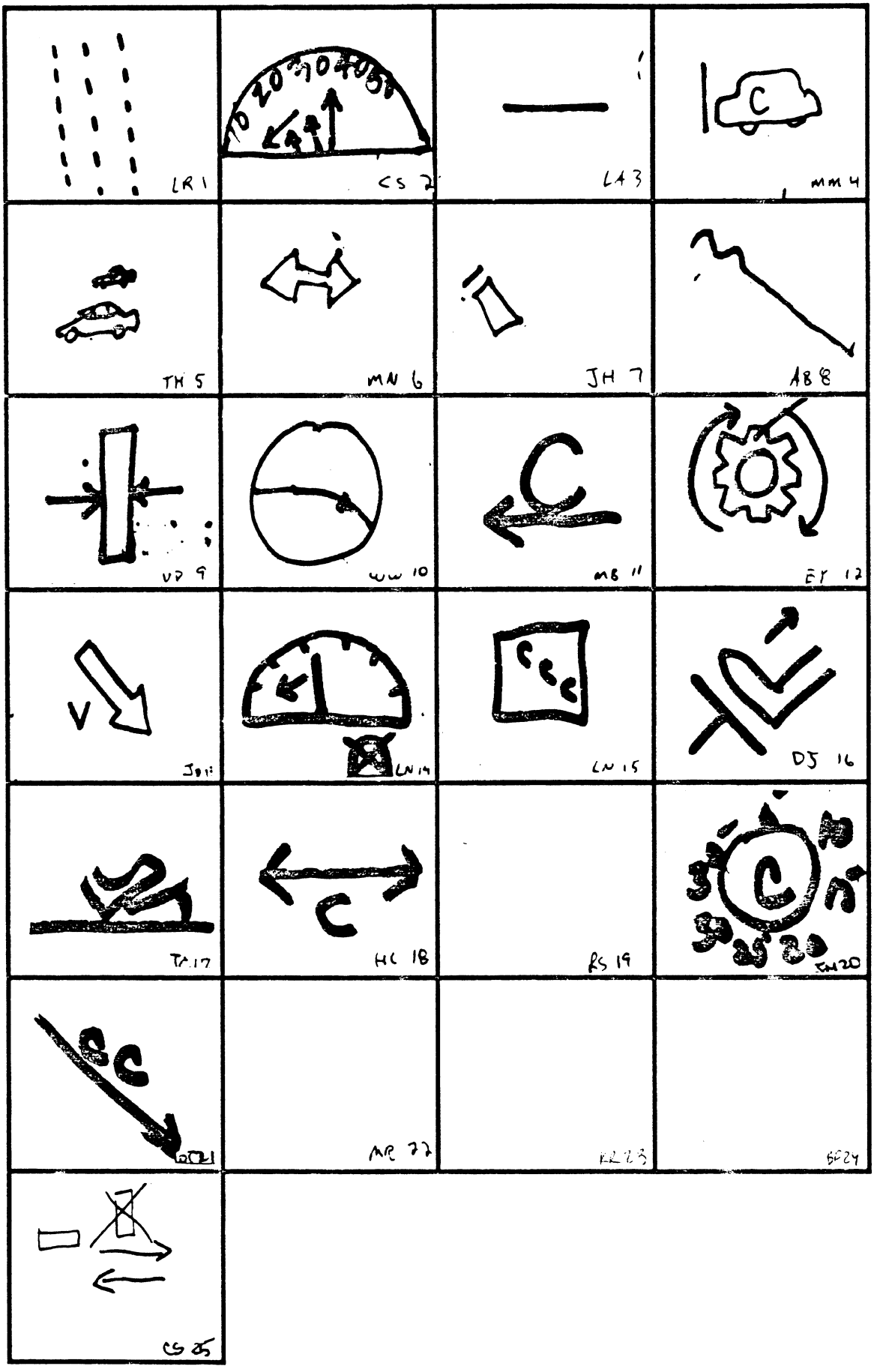
Suggestions for Cruise Control Resume Symbol

(n = 25)



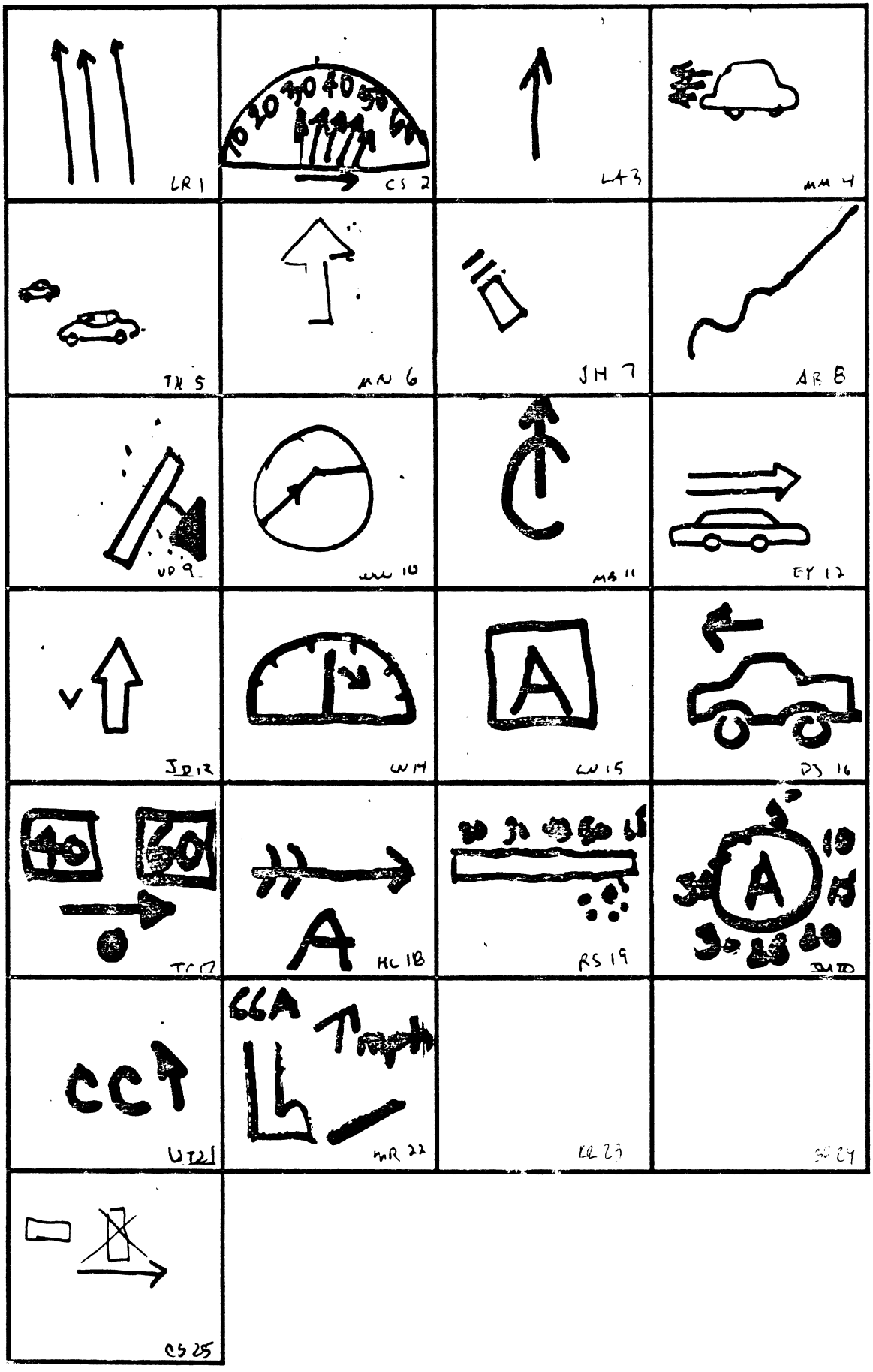
Suggestions for Cruise Control Coast Symbol

(n = 25)



Suggestions for Cruise Control Accelerate Symbol

(n = 25)



Suggestions for Cruise Control Decelerate Symbol

(n = 25)