United States Patent

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[54] **RAILROAD YARD INFORMATION SYSTEM**
9 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **340/23,** 246/124
[51] **Int. Cl.** **B61l 17/02**
[50] **Field of Search** ..... 246/122, 124, 2, 131, 134; 340/23, 24, 146.3 X; 235/61.11

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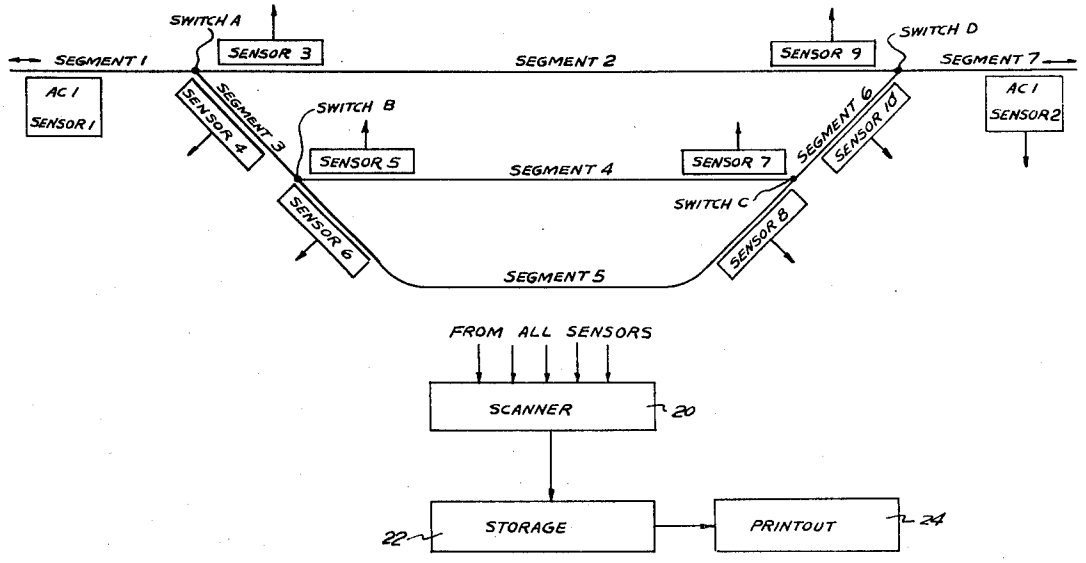
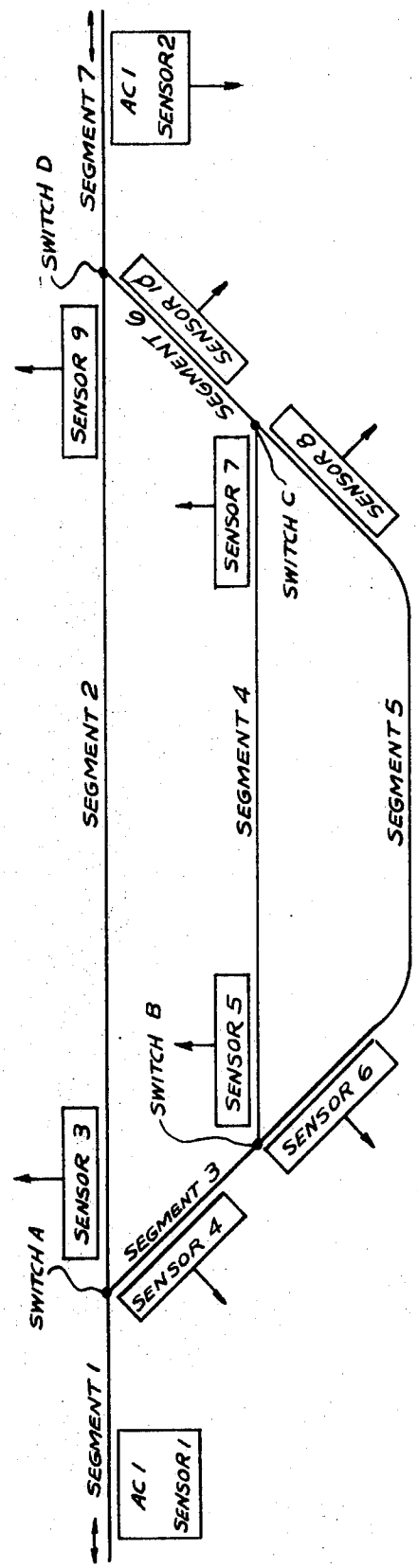
ABSTRACT: A system for indicating the positions of a number of railroad cars situated within a yard which has a pair of inlets and outlets and a plurality of track segments between the inlets and outlets, connected to one another by switches, includes first sensors at the inlets and outlets which scan indicators fixed to passing cars to provide electrical signals identifying the car and the direction of its motion. A second type of sensor is disposed at two of the three track segments which adjoin each switch point to provide signals indicative of the direction of motion of passing cars. The outputs of both forms of sensors are provided by a scanning unit to a general purpose computer which has a core storage area assigned to each track segment. Each core area stores words identifying the cores presently in the track segment it represents. Car identification numbers are added or subtracted from the list of cars contained within the segments adjoining the inlets and outlets under control of the first sensors and car-identifying numbers are manipulated between the core areas under control of the second sensors. A variety of reporting readouts may be obtained from the computer.





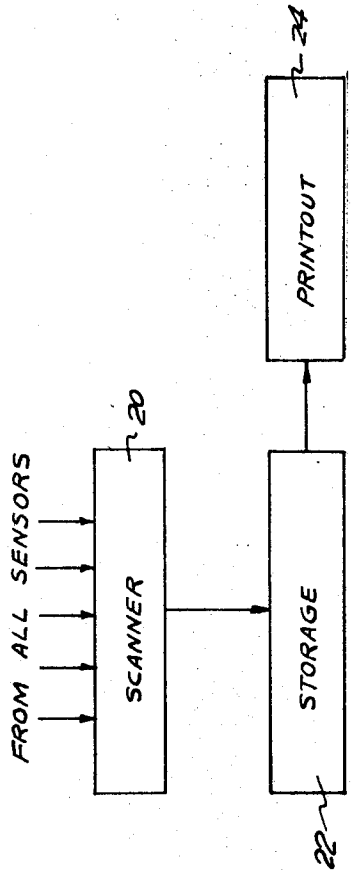


FIG. 1

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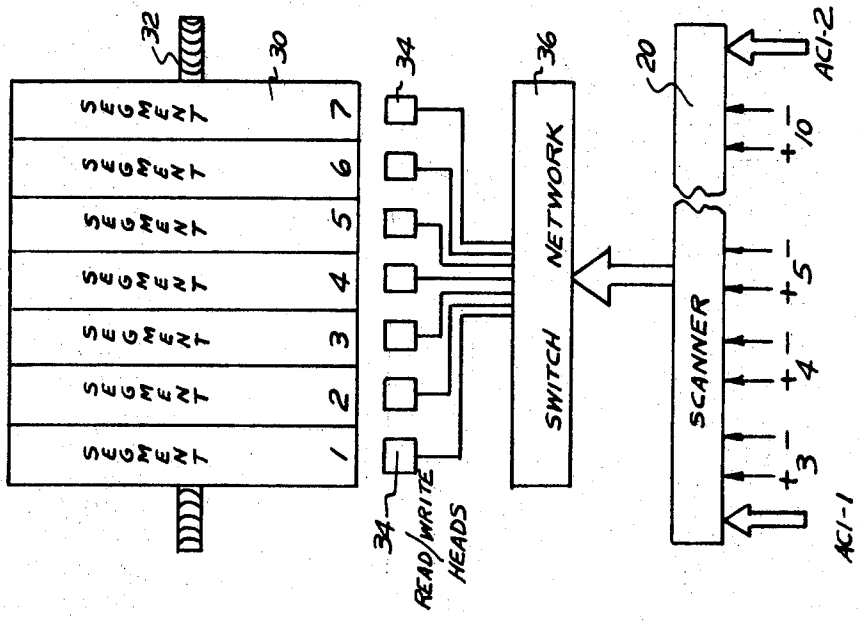

FIG.3

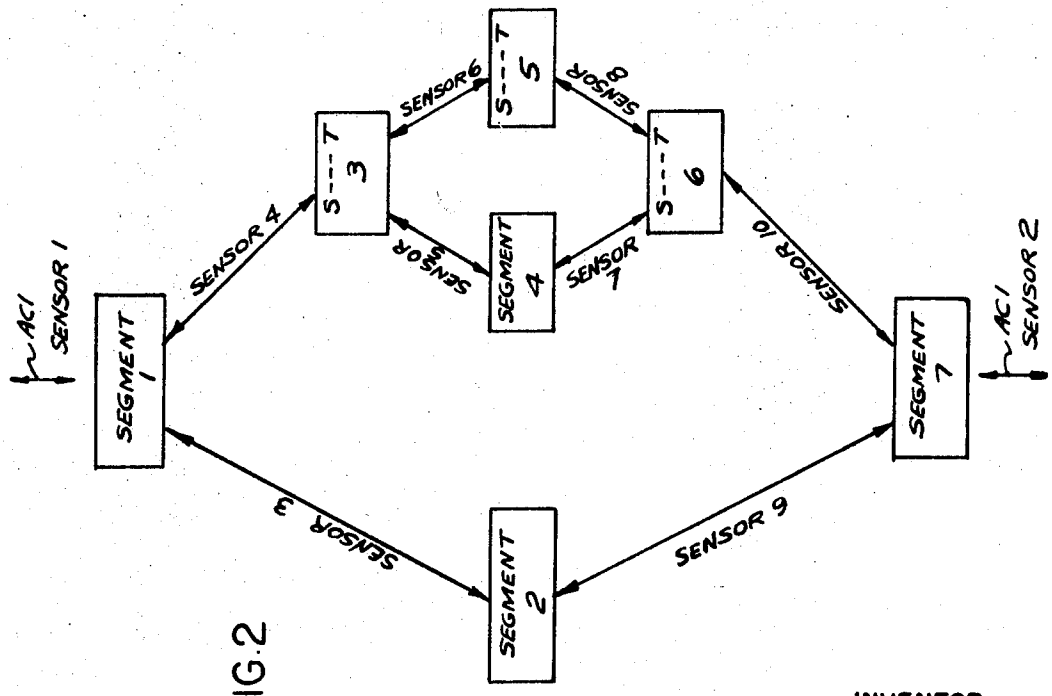

FIG.2

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RAILROAD YARD INFORMATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to arrangements for collecting and storing information on the positions of railroad cars within a track system and more particularly to a system which identifies the locations of cars within yards having a plurality of segments.

2. Description of the Prior Art

The problem of determining the positions of railroad cars within a track system has been partially solved in recent years by the adaption of automatic car identification systems. A variety of such systems is commercially available and typically they include some form of indicia such as colored markings which are disposed on the sides of the car. A scanner positioned along the track senses the marking as the car passes and generates an electrical signal which is a function of the markings. These signals are decoded or modified to a suitable form for provision to suitable printout or data processing equipment.

These units have been termed "automatic car identification (ACI)" systems and will be designated by that term hereinafter.

By use of such identification systems the railroads have been able to automatically obtain information on the location of cars in a form suitable for data processing use and a variety of reports which were previously unavailable or required extensive manual effort can be automatically prepared on a real time basis.

Equipment for sensing relatively long car identification numbers while the cars are passing at high speeds is inherently complex and costly. Accordingly, ACI systems have not seen general adoption within railroad yards so that a relatively precise indication of car position may be obtained but have rather been restricted in use to major rail locations; i.e., scanners are typically located on tracks leading into and out of major rail centers so that information may be generated about the arrival and departure of a particular car but the sensors will not be employed to determine the precise location of a car within a large rail yard.

While it would be feasible to provide ACI sensors at each branch of a switch point within a yard so that high accurate information on the positions of cars within the yard would be available, the cost of such a system would be so great as to outweigh the advantages which would result from it. Accordingly, the present practice is to maintain information on the general location of cars within a rail system employing ACI devices and to locate the exact position of individual cars through a manual location and reporting system.

SUMMARY OF THE PRESENT INVENTION

The present invention contemplates an automatic data-collecting system which will provide the precise location of cars at a substantially lower cost than the provision of a full ACI system. The system of the present invention provides the same information as would be available from a full ACI system.

The present invention is specifically intended for use in railroad yards wherein a plurality of track segments are interconnected by switches. Such yards may have any number of tracks which act as inlets and outlets and couple the yard to an external rail system but typically the yard has relatively few of these inlet and outlet tracks and a relatively large number of switch interconnected segments. For illustrative purposes the preferred embodiments of the present inventions, which will subsequently be disclosed in detail, will constitute yards having only two inlet and outlet tracks and a larger number of segments interconnected to one another and to the inlets and outlets through two-position switches.

Broadly, the present invention provides ACI-type sensors at the inlet and outlet tracks to provide signals to the system indicating the identification number of cars entering and leaving the yard. It also provides simpler sensors capable of providing signals representation of the fact that a car has passed a particular point, and the direction of motion of the car, without any identification of the car. These sensors are provided to at least two of the three track sections which connect at a switch point.

The signals from both types of sensors are provided to a multiplexer unit which scans them at a high rate and provides them to a memory device which may either take the form of a general purpose computer, properly programmed, or a hard-wired special computer comprising a memory section and appropriate control devices. Either form of device will contain certain areas of storage which are equal in number to the number of track segments within the system. The information from the sensors is provided to the storage and manipulated between the storage sections in such a manner that a storage section associated with a particular track segment contains signals identifying all the cars contained within that segment at any time. For example, assume the storage section dedicated to a particular track segment constitutes a number of word locations in a core-type memory, with a set of word locations being used to identify each car. If three cars are located within the track segment associated with that memory section at a given time, the memory will contain three sets of words, each representative of one of the cars. The word sets will be arranged in the same order that the cars arranged along the track segment; that is, the set closest to one end of the dedicated core section will represent the identification number of the car which is closest to one of the ends of the track segment and the set closest to the other end of the memory section will be representative of the identification number of the car closest to the other end of the track segment.

The system operates by adding or subtracting identification signals from the memory sections representative of the inlet and outlet track segments under control of the signal from the ACI sensors. The signals are added to or removed from the ends of the sections which are representative of the ends of the segments adjacent to the ACI sensors. The signals from the simpler sensors control the removal of the car-identifying word set from one memory section and its inserting at the appropriate end of the memory section representative of the track segment to which the car has moved.

Employing suitable peripheral equipment the system can readily print out the identifications and locations of all cars within the system. By sampling the storage sections the location of any particular car may be likewise determined. A large number of other useful reports representative of such things as the number of transfers and time required for transfers may also be prepared by appropriate manipulation of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, advantages and applications of the invention will be made apparent by the following detailed description of two preferred embodiments of the system. The descriptions make reference to he accompanying drawings in which:

FIG. 1 is a schematic diagram of the system operating on a simplified rail yard with the major components of the system illustrated in block form;

FIG. 2 is a schematic diagram illustrating the patterns of transfer of information relating to car movement between the segments; and

FIG. 3 is a schematic diagram of an embodiment of the invention employing a special purpose computer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a simplified rail yard which has the system of the present invention applied to it is illustrated in FIG. 1. The inlets and outlets whereby cars may be moved to and from the yard are illustrated at the extreme left and extreme right of FIG. 1. The leftmost track section, identified as

segment 1, provides one connection to the yard while the rightmost track section, identified as segment 7, provides the other inlet and outlet for the yard. A switch, designated SWITCH A, at the right end of segment 1, connects to a pair of track sections identified as segment 2 and segment 3. A second switch designated SWITCH B, connects the other end of segment 3 to a pair of segments designated 4 and 5. A third switch, SWITCH C, connects the other ends of segments 4 and 5 to a segment 6, while a fourth switch, SWITCH D connects the far ends of segments 2 and 6 to segment 7 which is the other inlet and outlet to the system.

All of the switches illustrated are the two-position variety. For example, a train moving right on segment 1 may be switched to either segment 2 or segment 3. Trains proceeding to the left on segments 2 and segments 3 may be only switched to segment 1. It is not possible for a train moving left on segment 2 to be switched on to segment 3 by SWITCH A.

To monitor the positions of cars moving on the track system of FIG. 1 a sensor denoted as ACI SENSOR 1 is disposed adjacent to the track of the extreme left end of segment 1. The ACI sensor may be of the type manufactured by Sylvania Corporation and marketed under the trademark KarTrak ACI system. Such sensors employ optical elements in a trackside device which interacts with a label disposed on each railroad car in the form of strips of reflective sheeting of various colors. The sensor detects the various strips in a passing car and generates an electrical signal which may be used to identify the car and its direction of motion. A similar sensor located at the right end of segment 7, and identified as ACI sensor 2, provides a signal identifying cars entering or leaving the yard by segment 7. While the output of an ACI sensor may be a plurality of binary words, these may be either used directly or converted to a simpler form in a digital dictionary for use in the system. For example, if the system can only hold 100 cars, a single seven-bit word could be used to identify the car and its full identification number could be obtained by reference to the dictionary. In the following description the term "Word" should be considered to encompass both the raw ACI output and such converted signals.

A pair of sensors of a second simpler type are disposed alongside each switch at the track segments which form an acute angle with respect to one another. For example, a pair of these simpler direction-sensitive sensors are disposed at the sides of segments 2 and 3 adjacent to SWITCH A which connects these two segments to segment 1. Signals from these two sensors, designated sensor 3 and sensor 4, provide complete information on the transfer of cars between segments 1, 2 and 3 via SWITCH A. For example, a signal from sensor 3 indicating that a car has passed and is moving to the right indicates a transfer of a car from segment 1 to segment 2. Similarly, a signal from sensor 4 indicating that a car has passed going in the direction of segment 1 indicates a transfer from segment 3 to segment 1.

FIG. 2 illustrates the manner in which the various sensor signals provide signals representative of the movement of a car from one segment to another. For example, a signal from sensor 3 indicates a transfer between segment 1 and segment 2 and the direction of the signal indicates the direction of the transfer.

Each of the other three switches in the system if also serviced by a pair of sensors to indicate transfers between the connected segments.

It should be recognized that the system of the present invention could be used with more complex switches which would provide a greater choice of car destinations, and in that case a larger number of sensors would be required to provide the system with information.

The sensors employed at the switch points might be any of a wide variety of direction-sensing transducers which are commercially available. For example, they might be any of the type which employ a pair of pressure-sensitive switches and logical circuitry to determine the sequence in which the switches are actuated.

The signals from all of the sensors are provided to a scanner 20. The scanner rapidly samples the lines from all of the sensors and provides an appropriate signal to a storage unit 22 as the signal is received from one of the sensors. The storage unit 22 broadly provides a plurality of sections, one for each of the track segments, and each section contains room for signal representing all the cars which may be disposed in that track segment at any one time. Under control of the signals from the scanner, the storage unit adds or subtracts car-identifying numbers to segments 1 and 7 as cars pass the ACI sensors 1 and 2, respectively, and transfers from the storage areas representative of signals 1 and 7 to and from the other storage areas under control of the other sensor signals.

A printout unit 24 may provide readouts of the status of the storage unit 22 at any particular time or may provide the location of a particular car depending upon the method of interrogation.

In one preferred embodiment of the invention the storage section 22 and printout 24 will take the form of a general purpose computer. While almost any commercially available general purpose computer would be to the required operation the system will be described in terms of the PDP–8 computer manufactured by Digital Equipment Corporation, Maynard, Massachusetts, which is a low-cost manufactured in large quantities.

The entire I/O bus of the computer would be provided to the scanner 20. Upon the scanner, detecting a signal from one of the sensors, it would signal the computer requesting a data break wherein the computer's normal program is interrupted while information is transferred between the scanner and the computer. Upon the computer's central processing unit signalling the computer that the data break had been granted, the scanner would provide to the computer buffers storage register the identifying signals received if the data break was initiated by an ACI sensor. It would also provide the computer with the address of a memory location at one extreme end of the core section dedicated to either segment 1 or segment 7, depending upon this source or origin of the signal. The computer would then go through a routine wherein the number received from the ACI sensor was either added to or deleted from the appropriate core section.

Upon receipt of a signal from one of the simpler scanners, the computer would delete a word from an appropriate end of the core section assigned to one of the track segments and add that same identifying word to an appropriate end of another track segment. For example, a signal from sensor 9 indicating that a car had moved in the direction of segment 2 would cause the word stored at one end of segment 7 to be removed and to be added to the appropriate end of the core section assigned to segment 2. Periodically, the computer would go through a routine where the words stored in each segment would be appropriately shifted to make room for the addition of other words.

FIG. 3 schematically illustrates a hard-wired version of the storage section of the system employing a magnetic drum memory 30. The drum, which rotates about axis 32, is divided longitudinally into seven peripheral track sections identified as segment 1–7. A read/write head 34 is provided for each of the segments.

The signals from the scanner 20 control a switch network 36 that provides the read/write heads associated with channels 1 and 7 with numerical information from the sensors ACI 1 and ACI 2; and controls the transfer of car-identifying numbers between the various segments under control of the signals from the other sensors in accordance with the pattern of FIG. 2. The heads 34 read and write information from the ends of the strings of information contained on a particular segment. In this arrangement there is no need to shift the information in a segment away from an end when crowding occurs at the end of the section since the read and write spaces are continuous and formed in a closed circle.

Upon receipt of a signal from one of the sensors 3–10 information is read from one end of an appropriate segment and

written onto an appropriate end of another segment in accordance with the diagram of FIG. 2.

Having thus described my invention, I claim:

1. A car location information system for a rail yard having a plurality of track segments interconnected by switches, comprising:

first sensor means disposed adjacent to the inlets and outlets to the yard operative to provide electrical signals identifying cars moving in and out of the yard and their direction of motion;

a plurality of second sensors disposed adjacent to the switch connections operative to provide signals identifying only the direction of motion of cars passing the sensors;

a storage device having a plurality of information storage sections equal in number to the track segments, one storage section being associated with each track segment and each storage section being capable of storing a number of car-identifying signals equal to the number of cars which may be retained on its associated track segment; and

means under control of signals from the first sensor means for adding car-identifying signals to and removing car-identifying signals from at least certain storage sections and under control of signals from said second plurality of sensors for transferring car-identifying signals between various sections of said storage.

2. The system of claim 1, wherein said rail yard has a first number of inlet and outlet sections, said first sensor means comprises a plurality of sensors one of which is associated with each of said inlet and outlet sections, and the storage sections which car-identifying numbers are read into and removed from under control of the first sensor means are associated with track segments directly connected to said inlets and outlets.

3. The system of claim 1, wherein said first sensor means cooperate with indicia formed on the cars to provide output signals indicative of the identification of a car passing a particular point.

4. The system of claim 1, in which all of the switches are two-position switches and second sensors are disposed adjacent to two of the rails leading to each switch.

5. The system of claim 1, wherein certain of said track segments constitute inlets and outlets to the yard and the car-identifying signals which are added to and removed from at least certain of the storage sections under control of signals from the first sensor means are added to or removed from sections associated with these segments.

6. The system of claim 1, wherein the storage device having a plurality of information storage sections constitutes the storage section of a general purpose computer and the means under control of signals from the first sensor means for adding car-identifying signals to and removing car-identifying signals from the certain storage sections and under control of signals from said second plurality of sensors for transferring car-identifying signals between various sections of said storage constitutes the control section of the same general purpose computer.

7. The system of claim 1, wherein the storage device having a plurality of information storage sections constitutes a rotary magnetic drum with each storage section occupying a complete annular ring on the drum.

8. The system of claim 1, wherein means are provided for determining the storage section in which a particular car-identifying signal is stored and for determining all of the car-identifying signals contained within one storage section at any given time.

9. The system of claim 1, wherein a car-identifying signal is added to one of the storage sections upon receipt of a signal from said first sensor means, indicating that a particular car is moving into the yard and car-identifying signals are removed from certain storage sections upon receipt of signal from said first sensor means, indicating a car is moving out of the yard.