Nov. 17, 1953 P. H. BURN ET AL 2,659,109

ALL RAMP GARAGE

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Fig. 1.

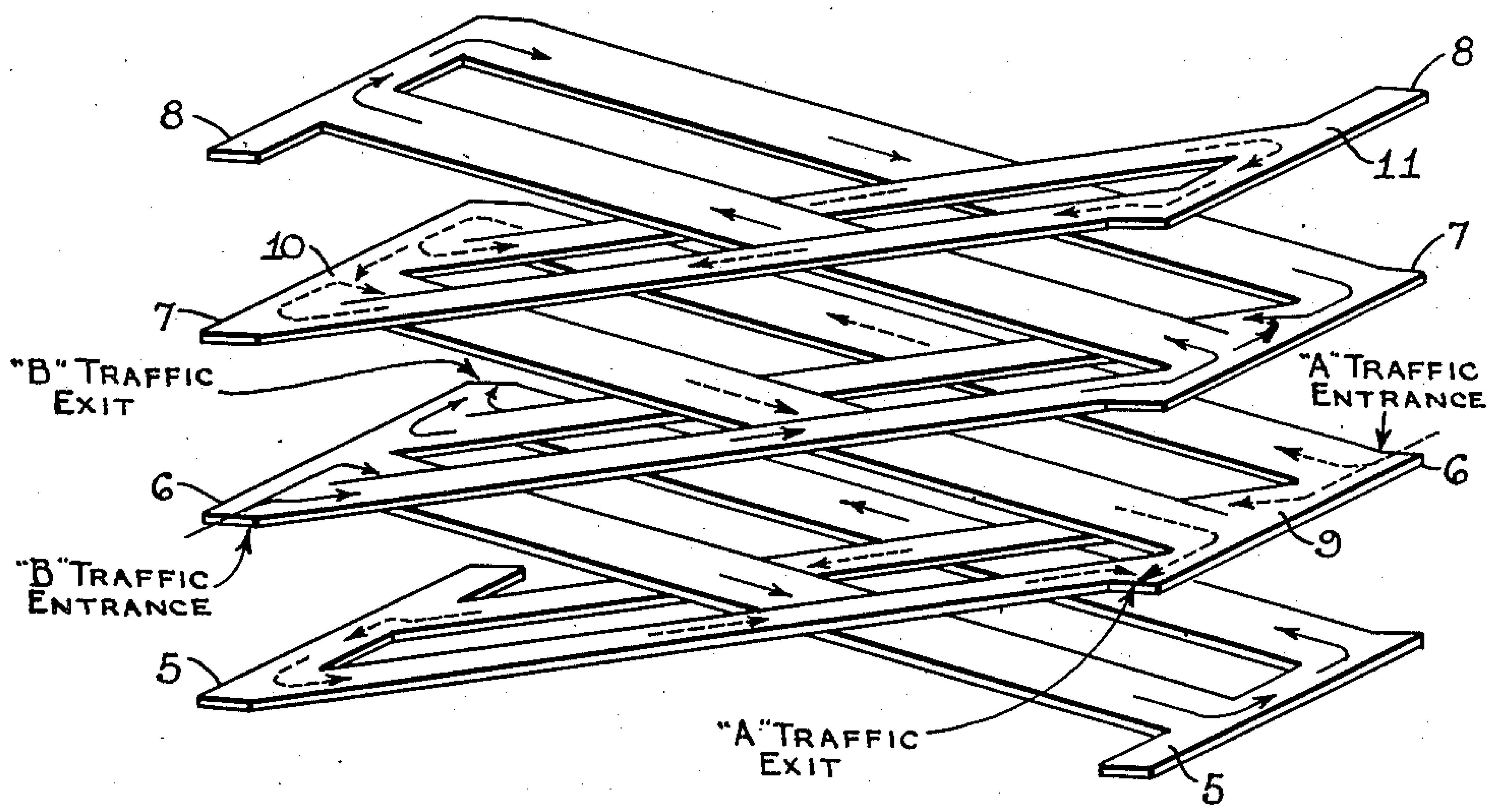

Fig. 2.

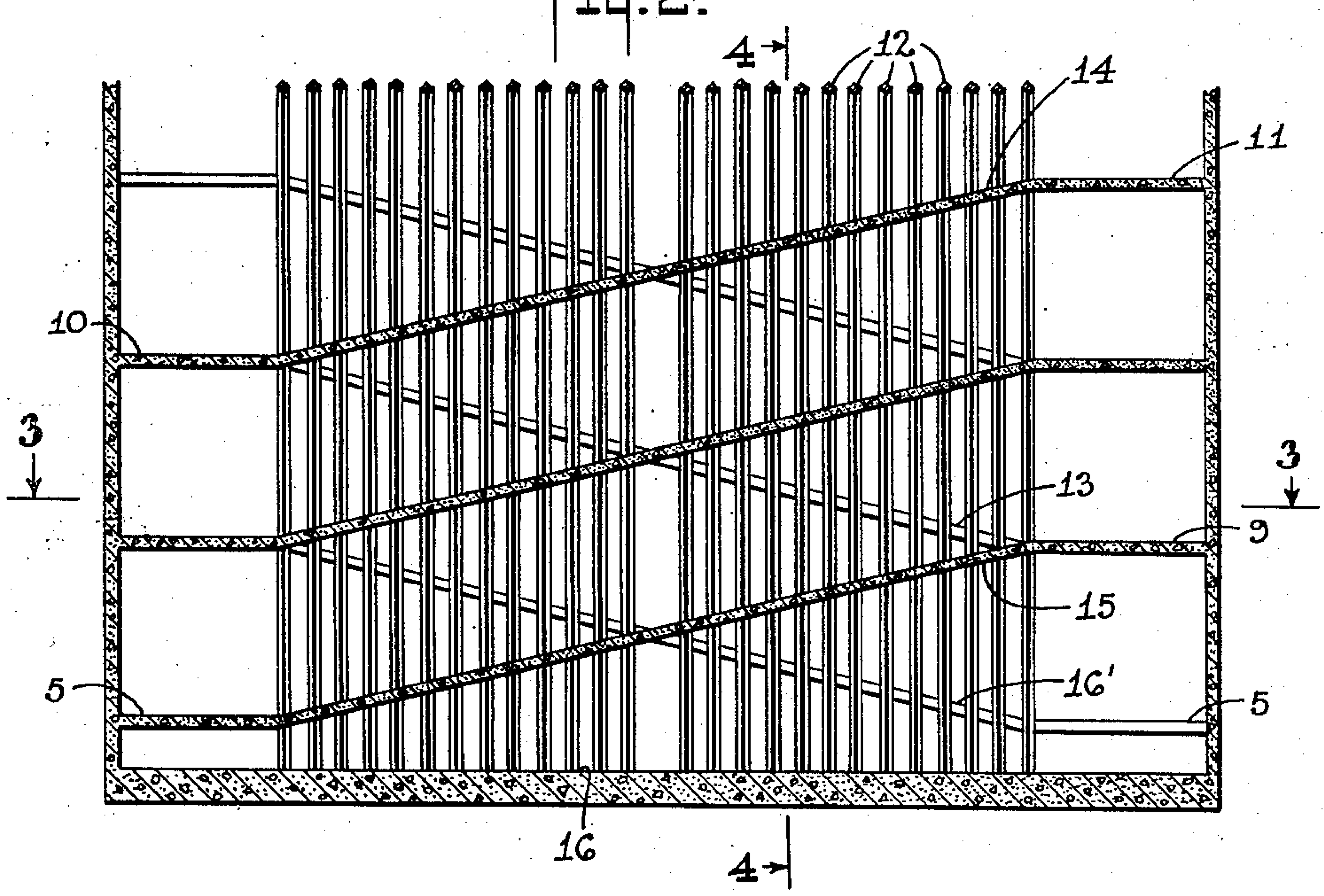

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Fig. 3.

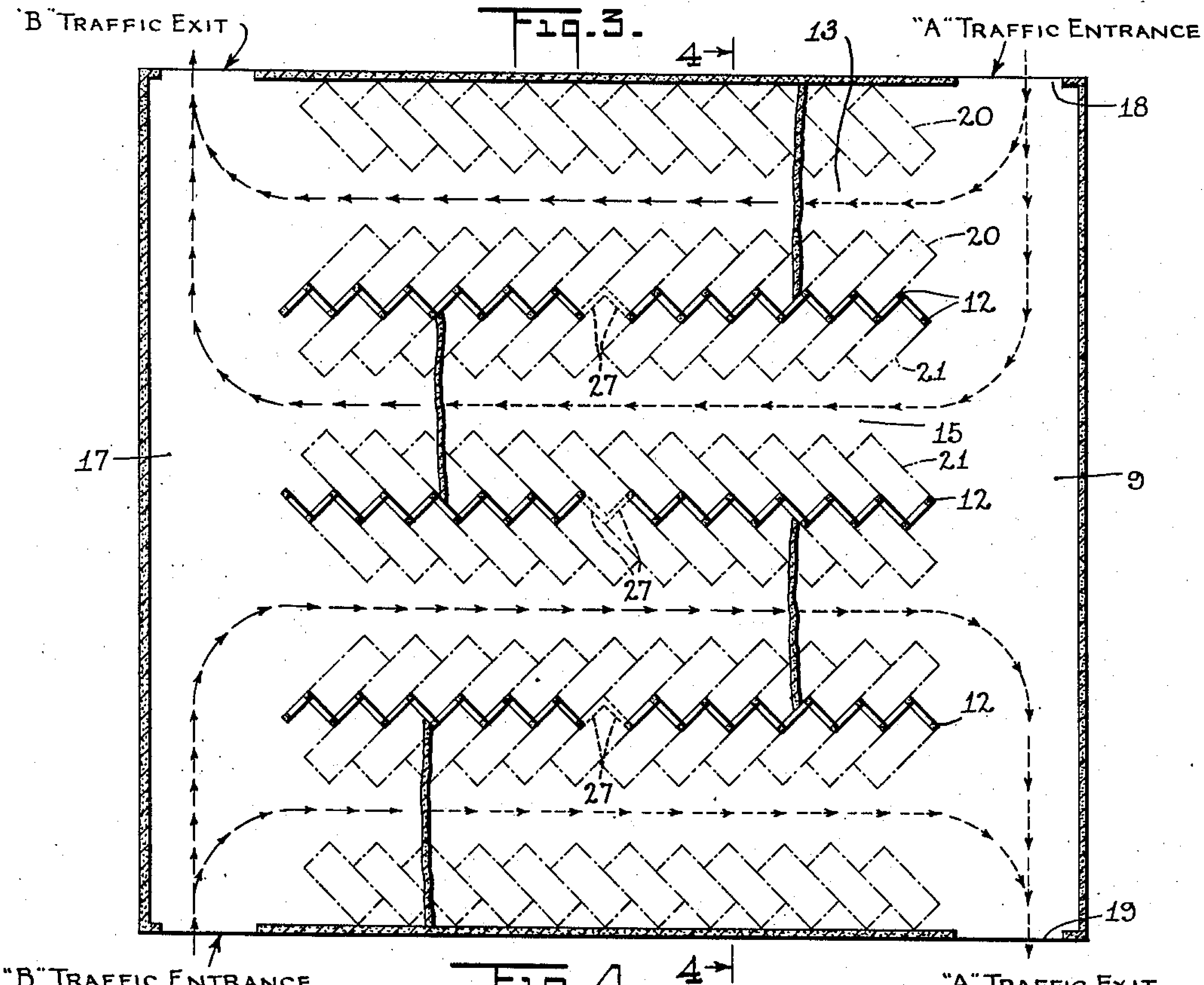

Fig. 4.

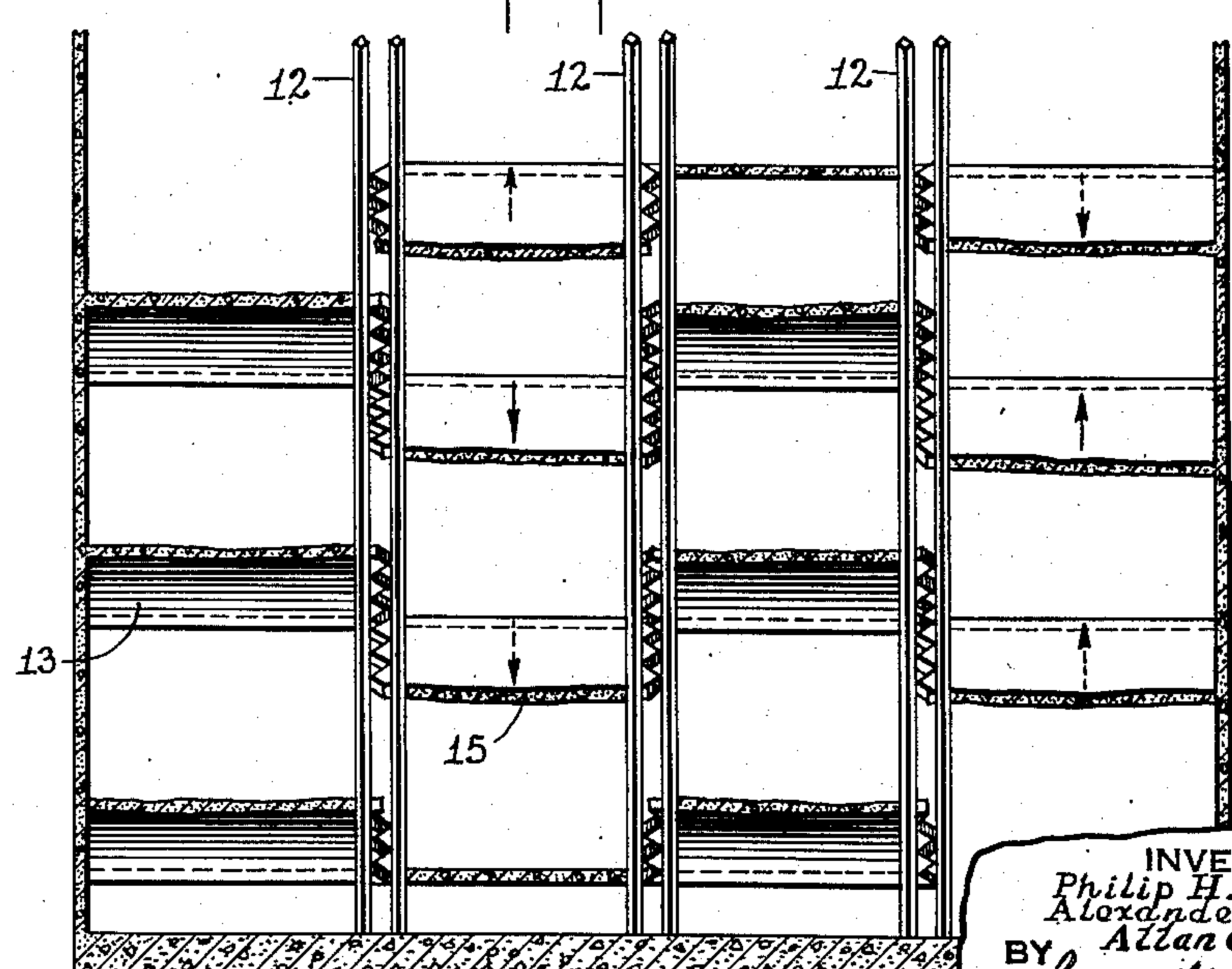

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Fig. 5.

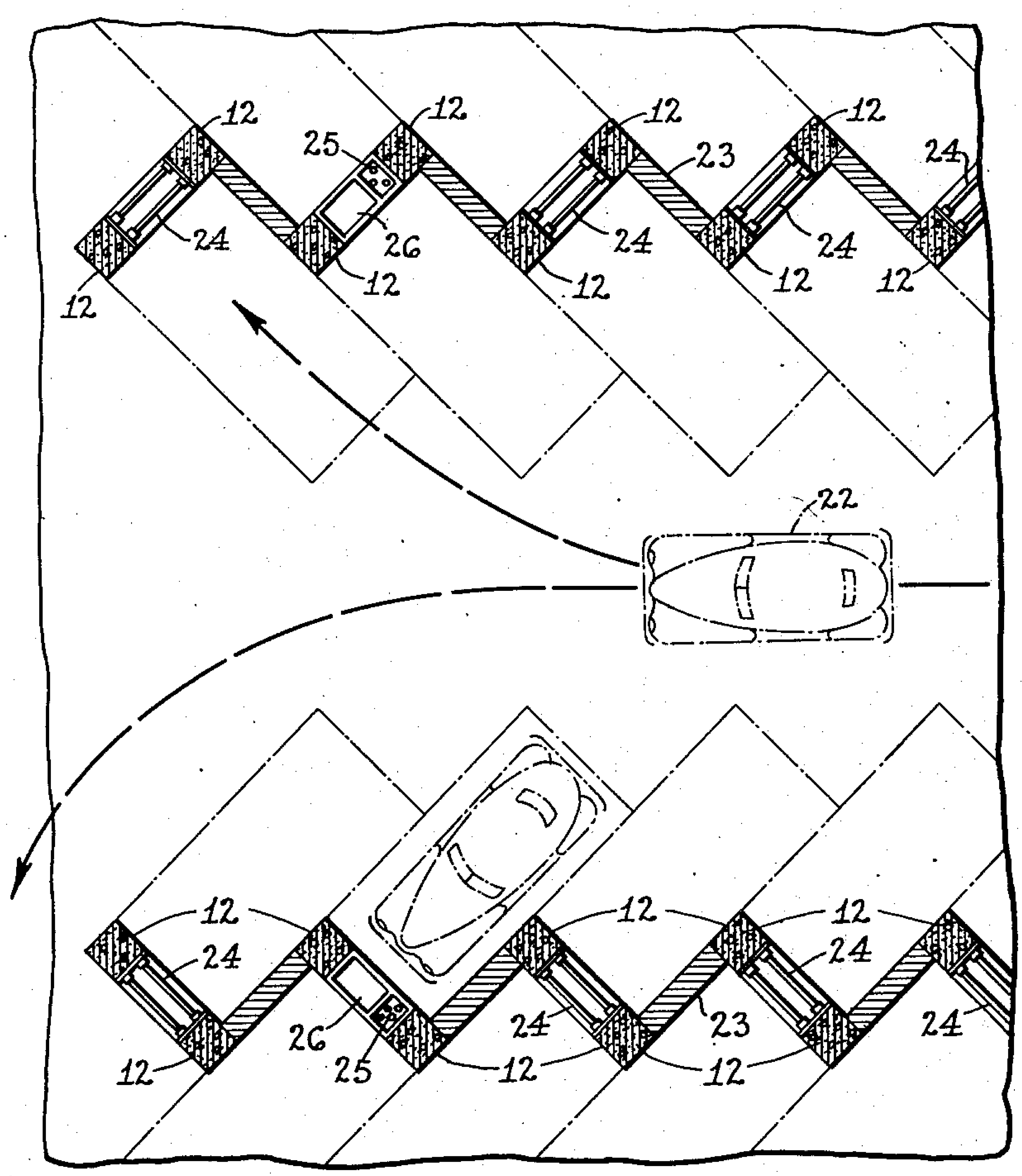

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Fig. 6.

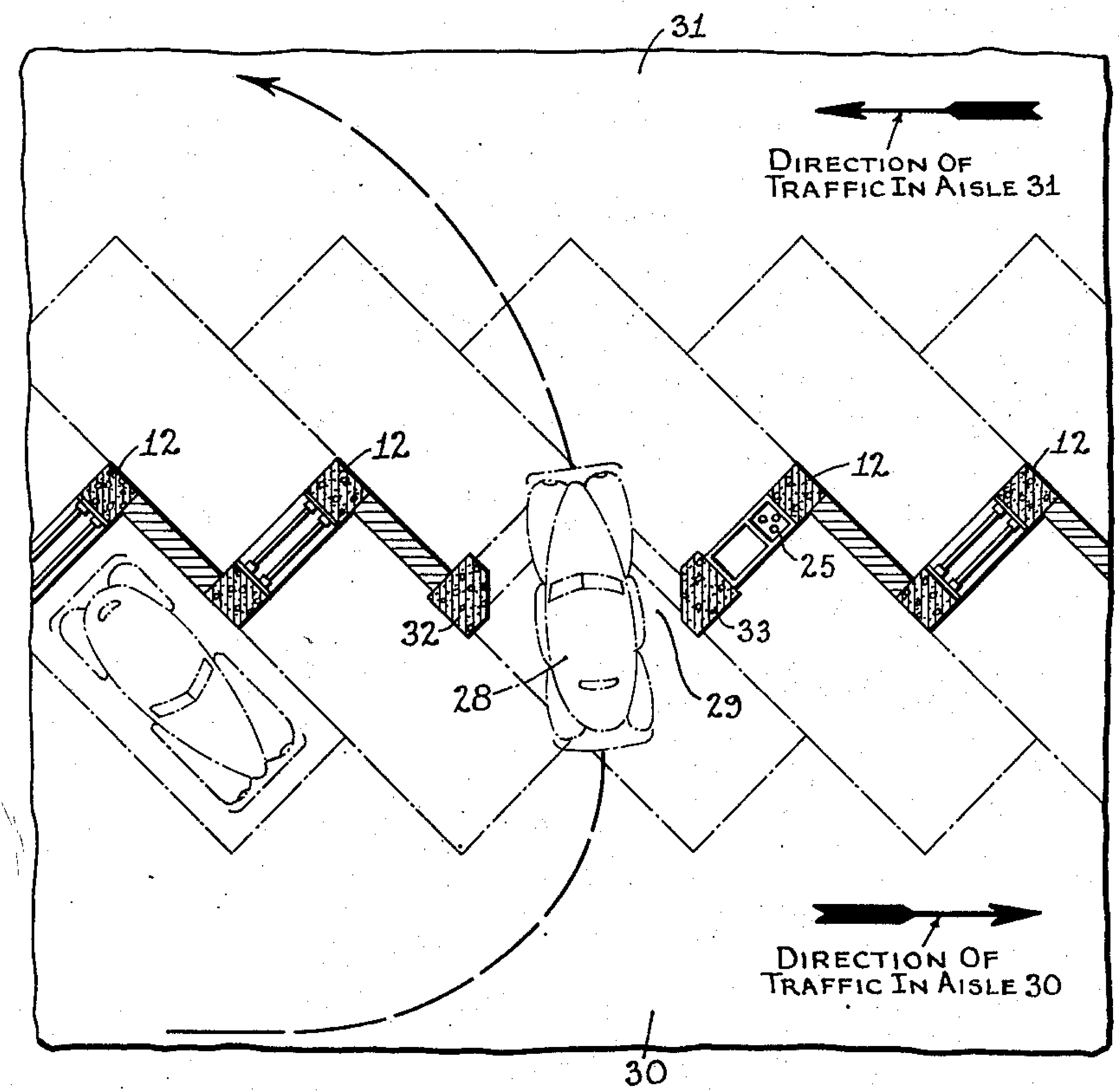
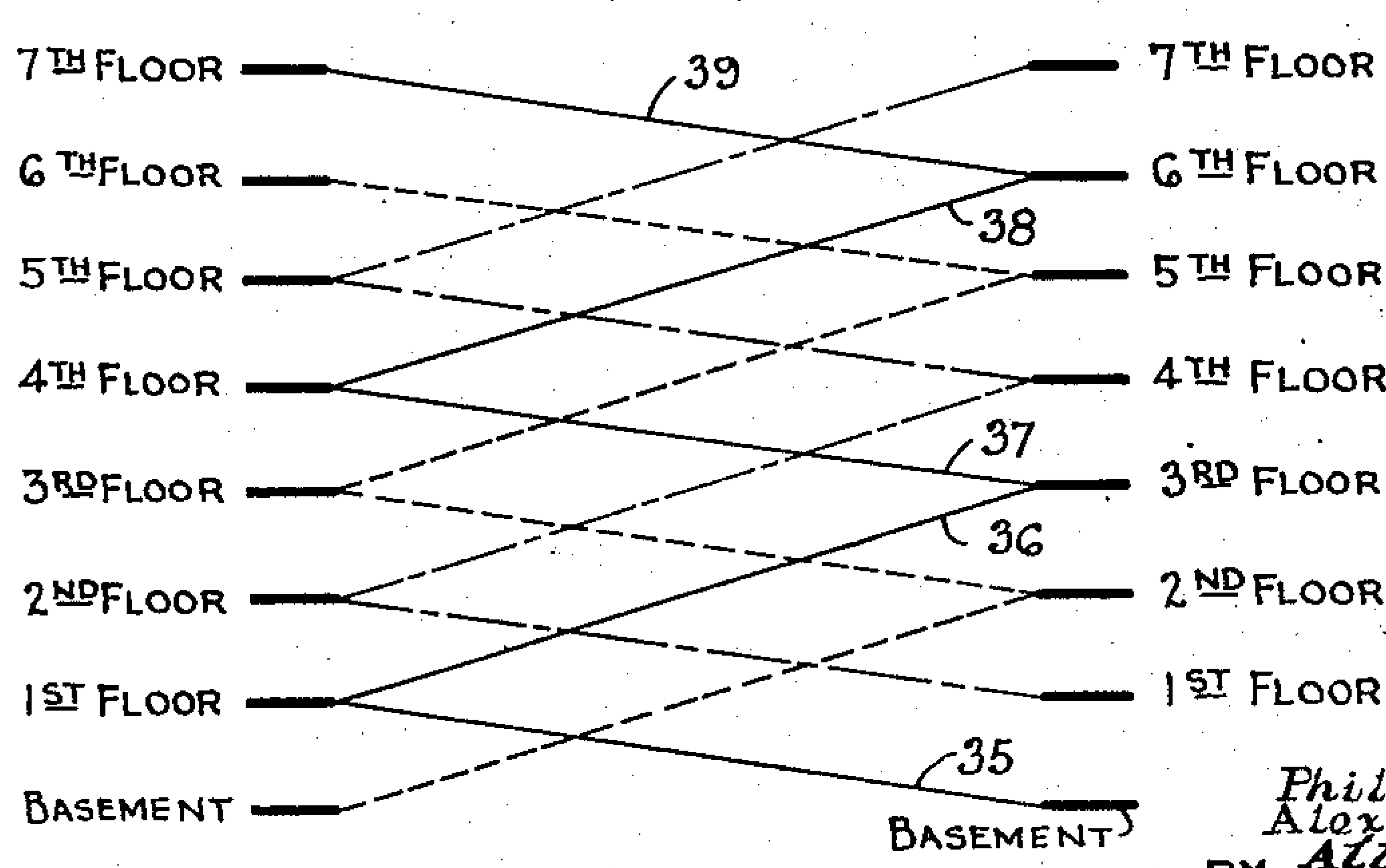


Fig. 7.



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ALL RAMP GARAGE

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Application April 13, 1946, Serial No. 661,964

1 Claim. (Cl. 20—1.13)

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Our invention relates to garage buildings having a plurality of floor levels and in particular to the type of garage in which a more or less continuous series of ramps is employed for vehicular communication between floor levels and in which substantially all parking is accommodated on the ramps themselves.

In ramp-type garages of conventional construction a single system of ramps is employed. Each ramp extends virtually the length of the building and may accommodate parked vehicles on both sides of the stream of traffic. Ramps slope in both directions, but the arrangement is such that in a single traverse the length of the building, the ascent is only one-half a story, that is, only one-half the distance between floor levels. Thus, a double traverse of essentially the full length of the building is necessary in order to ascend from floor to floor. Inordinate travel distances are, therefore, involved in reaching the more remote parking spaces in the conventional arrangement of a ramp-type garage. Also, the conventional ramp garage provides but one traffic route to a particular parking location; the difficulty with this limitation is more apparent when a traffic-block or congestion develops for one reason or another.

It is accordingly an object of our invention to provide an improved ramp-type garage wherein essentially all the parking of vehicles is accommodated on the ramps themselves.

It is also an object to provide a ramp-type garage having a plurality of traffic routes whereby the ability to handle traffic is not seriously impaired by local traffic stoppages or congestion.

It is another object to provide a ramp-type garage in which travel to remote parking rectangles is materially reduced over that required in conventional arrangements.

In general, it may be said that it is our object to provide an improved structure for self parking, which will be to a high degree self directing and which will afford easy and rapid means of access and egress while effectively utilizing the available space.

Other objects and various further features of novelty and invention will appear from a reading of the following specification in conjunction with the accompanying drawings, in which:

Fig. 1 is a generally schematic isometric view of the interrelation of ramps in a garage incorporating features of the invention;

Fig. 2 is a longitudinal vertical sectional view of a garage according to Fig. 1 but showing in addition the arrangement of supporting columns for the ramps;

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Fig. 3 is a sectionalized plan view of the garage of Fig. 2 taken essentially in the plane 3—3 of Fig. 2;

Fig. 4 is a sectionalized elevation taken essentially in the plane 4—4 of Figs. 2 and 3;

Figs. 5 and 6 are enlarged fragmentary plan views in partial section showing details of the garage of Fig. 2; and

Fig. 7 schematically illustrates an alternative ramp arrangement.

Broadly speaking, our invention contemplates a garage in which substantially all parking is accommodated on ramps and in which such a plurality of ramp systems is provided that the total travel distance to parking rectangles is substantially one-half that involved in conventional ramp-type garages. Also, the invention contemplates provision of cross-over connections between such ramp systems whereby alternative routes may be taken to or from parking rectangles, should local congestion of traffic develop in one or more parking aisles or ramps. In the specific forms to be described, each system of ramps includes up and down traffic lanes which are intercommunicating at every floor level, and each system of ramps may utilize a separate entrance and a separate exit from and to street traffic.

Referring to the schematic diagram of Fig. 1 our invention is shown in connection with a ramp-type garage employing two essentially independent systems of ramps in a structure having four floor levels. These four levels may comprise a basement **5**, a first or street floor **6**, a second floor **7**, and a third floor **8**. For the special case considered in Fig. 1 the same floor levels will be recognized at opposite ends of the structure.

As indicated above, the garage layout of Fig. 1 includes two essentially independent systems of parking ramps. These are designated system A and system B. Entrance to ramp system A is made from the street level **6** at the far right-hand corner of the layout shown, and normal traffic routing throughout ramp system A is indicated by arrows having dotted tails. It will be noted that for communication between any two adjacent floor levels ramp system A provides at least two lanes of one-way traffic—one up and one down. Oblique-angle parking may be effected on both sides of each of these lanes in a manner to be described later.

Ramp system B is essentially the same as ramp system A with the exception that, for ramps communicating between any two adjacent floors, all slopes are opposed to the slopes of ramps in system A. Plain arrows indicate the flow of traffic throughout system B, which is shown to have provision for entrance from the street level 6 at the near left-hand corner of the building—diagonally opposite from the entrance to the ramp system A. As in the case of system A, ramp system B is provided with at least two lanes of one-way traffic between any two adjacent floor levels. To make for efficient utilization of the available width in a given garage structure, the lanes of one system of ramps interlace the lanes of the other system. For example, the down lane of ramp system B between floor levels 6 and 7 is intermediate the up and down lanes of ramp system A communicating between these two floor levels.

For each system of ramps there is provided at each floor level a landing communicating with all traffic lanes which terminate at that floor level and at that end of the building. In the case of the street level 6 for ramp system A, landing 9 provides a means for selection of a route via an up ramp to the second floor 7 at the left end of the building or for a down route toward the basement 5 at the left end of the building. A landing 10 on the second floor 7 at the left end of the building likewise communicates with all ramps terminating at that floor level and at that end of the building, so that the motorists must again select a route—on the one hand, for travel up to the third floor 8 at the right end of the building and, on the other hand, down to the street level 6 at the right end of the building. Having reached street level at landing 9, he may either make exit to the street via the near right-hand corner or take a down ramp into the basement.

In operation, it will be apparent that travel distances to parking locations are virtually at a minimum with the arrangement shown in Fig. 1. Considering a parking space at the top landing 11 of ramp system A, parking may be effected by making only two runs substantially the length of the building—first, via the up ramp between landings 9 and 10 and, second, via the up ramp between landings 10 and 11. Exit requires about the same relatively short travel—via the down ramp between landings 11 and 10, and via the down ramp between landings 10 and 9.

The general arrangement of traffic lanes which has been described for the all-ramp garage of Fig. 1 is shown in Figs. 2, 3, and 4 to lend itself particularly well to the efficient utilization of interior supporting columns 12. In Fig. 2 these columns are shown to lie in essentially vertical planes defined by the mutual adjacency of a bank of ramps running upwards from left to right and of a bank of ramps running downward from left to right. Since the ramps are adjacent, each column 12 may serve to support ramps from both the described banks of ramps, without requiring individual structures for each set of ramps.

To assist in an understanding of the ramp systems shown in Fig. 2 features of the layout of Fig. 1 will be recalled. Ramp system A enters and exits on landing 9 at the street level and has communication with the landing 10 on the second floor (at the left end of the building) via upwardly sloping ramps in the plane of the up ramp 13. Communication with the third-floor landing 11 at the right-hand end of the building is via ramps sloping upwardly between landings 10 and 11 in the plane of the up ramp 14. In ramp system A, communication from the street landing 9 to the basement level 5 at the left-hand end of the building is via ramps in the plane of the down ramp 15. Although the columns 12 are shown in Fig. 2 to extend below ramp 15 to the foundations 16 of the building, it is clear that there need be no excavation to accommodate the portion of columns 12 extending below ramp 15 and that construction costs may be thereby reduced.

Considering now in more detail the layout of parking rectangles and traffic lanes for the structure of Fig. 2, reference is made to Fig. 3, which is a partially sectionalized plan view taken essentially in the plane 3—3 of Fig. 2. It will be apparent that this section 3—3 provides a view of ramps leading to and from the landings 9 and 17 at the street level 6. In the form shown, A traffic enters landing 9 through portal 18 and exits through portal 19. In attempting to find parking space on one of the up ramps of system A, motorists take their first turn right in a direction up ramp 13, which comprises a center lane for one-way traffic (indicated by centrally located dotted arrows) flanked on each side by parking rectangles 20 at acute angles to the traffic flow. Should a motorist decide to attempt parking in the basement, he would take the second turn right to ramp 15, where parking would be effected in one of the rectangles 21 flanking the downward stream of traffic in lane 15.

It will be noted that in a plan view such as shown in Fig. 3, the angularly disposed parking rectangles 20 of lane 13 and 21 of lane 15 (adjacent to lane 13) may be made closely to interfit so as to define essentially a serrated border between lanes 13 and 15. By providing adjacent ramps with serrated edges in which each serration accommodates the width of a parking rectangle, it will be clear that the available width in a garage structure may be more effectively utilized. Also, it is possible to dispose the support columns 12 at the corners of the serrations, where it is apparent that least interference with parked vehicles will occur.

The interrelation of support columns 12 and the serrations of a number of adjacent ramps may perhaps be better appreciated from the partially sectionalized view of Fig. 4, which is taken essentially in the vertical plane defined by section 4—4 of Figs. 2 and 3. Up ramp 13 and down ramp 15, which have just been described for the use of motorists entering the A traffic entrance, will be recognized at the left-hand side of Fig. 4.

Considering in still further detail the novel structural arrangements according to our invention, reference will be made to Figs. 5 and 6, which are enlarged fragmentary plan views taken respectively at the end and at the middle of adjacent ramps to be found within the garage building. Fig. 5 shows how a vehicle 22 in a one-way stream of traffic may readily turn into a parking rectangle or have ample clearance to turn into a landing for exit or for the purpose of exploring another ramp. The support columns 12 defining the serrated edges of the ramp are shown to be of customary reenforced-concrete construction, so that the entire garage structure may be monolithic.

The serrated edges flanking longitudinal sides of parking rectangles may be filled in as walls 23. It is preferred that these walls be relatively thin since they do not add structurally to the soundness of the building and since reduced width will mean the parking rectangle of one lane may be located closer to the parking rectangle of an adjacent lane, thus again effecting a saving in width requirements for each ramp and for the building.

For purposes of safety we provide a barrier at the serration flanking the short end of the parking rectangles. These barriers may be in the form of heavy pipes **24** securely mounted in the support columns **12** which they span. For more effective use of the space between support columns **12** spanning the serrated edge at the end of parking rectangles, we propose to employ some of these spaces for the accommodation of power conduits **25**, ventilating and heating shafts **26**, and other service facilities, as will be clear.

It has been indicated that the all-ramp garage structure thus far described provides two main alternative driving routes, whereby local traffic congestion may be relieved. As a feature of the invention, we provide for further relief of congestion by again adding to the number of alternative routes. The added routes are readily provided by omitting the central supporting column **12** for each adjacent pair of ramp systems. The spaces left by omitted columns may best be viewed in the elevation of Fig. 2 and in the plan view of Fig. 3, where the omitted-column space and the barriers which would have linked adjacent columns are indicated by dashed lines **27**. The elevation of Fig. 2 shows omitted-column spaces to occur at the intersection of vertical projections of adjacent slopes, thus permitting crossovers between adjacent ramps at these locations—at a sacrifice of but four parking rectangles for each crossover.

In the crossover detail of Fig. 6, a vehicle **28** is shown utilizing the crossover **29** from, say "A" traffic in aisle or ramp **30** to "B" traffic in aisle **31**. It is apparent that ample clearances may be provided to effect the possibly necessary 180° turn illustrated by the dashed-arrow path being followed by vehicle **28**. Since a column has been omitted to permit establishment of a crossover, we prefer to provide added strength in the adjacent columns **32**, **33** so as to redistribute the load. As indicated by the cross-sections shown for columns **32**, **33**, the added burden may be sustained in a larger cross-section without reduction in width clearance at the crossover.

It will be clear that since adjacent ramps, such as aisles **30** and **31**, are of opposite slopes, there may be a roadway discontinuity between columns **32**, **33** spanning the crossover between these ramps. For the slopes presently contemplated, this discontinuity is slight and may be reduced by a local levelling of the pavement. However, if desired, all ramps may be designed with level surfaces at the crossover levels.

Thus far, consideration has been given to the special (and perhaps most frequently occurring) case in which the garage structure is erected on essentially level ground, and in this case the same floor levels obtain for corresponding landings at opposite ends of the building. It should be understood, however, that the structural principle of our all-ramp garage permits of ready adaptability to various types of sloping terrain in which there may be differences in level between entrances and exits at either or both ends of the garage. If the prevailing slope is such as to effect a difference in level between the entrance and the exit of a given series of ramps, it is clearly not disadvantageous to provide the landings (particularly those on the street floor **6**) with slopes in conformity with that of the terrain; alternatively, exit may be made from a floor level other than that of entrance, or from one of the outermost ramps on the longitudinal side of the building.

Where a difference of street level exists longitudinally of the structure, that is, between the entrance landings of ramp system A and those of ramp system B, the structure may be readily adjusted for this difference by increasing the slope of aisles rising from one end of the building and by decreasing to a like extent the slope of aisles rising from the other end of the building; in this manner, both street landings may be made to coincide with street levels at points of entrance and of exit. Since the parking area is not constituted of the usual level floors, the modification which has just been described does not adversely affect the design of the building.

It will be appreciated that although we have described our invention with particular reference to a two-system garage, the underlying principle is adaptable to garages having n essentially independent systems of ramps. To illustrate, Fig. 7 schematically indicates the vertical projection of an eight-floor structure in which the ramp pattern is designed for the case of $n=3$, that is, for the case of three systems of ramps. Taking, for example, a first system in which the ramps are shown by solid lines **35**, **36**, **37**, **38**, **39**, one enters at the first or street-floor landing at the left and has the option of proceeding to the basement via ramp **35** or direct to the third, fourth, sixth, and seventh floors by successive traversal of ramps **36**, **37**, **38**, and **39**. Thus, to reach the most remote parking rectangle (presumably on the seventh floor), but four runs substantially the length of the building are required. The other two systems of ramps are indicated respectively by dashed and by dot-dashed lines, and they clearly follow the same general pattern as has been described for ramps **35**, **36**, **37**, **38**, and **39**. As in the case of the two-system layout described for Figs. 1 through 6, crossovers may be provided between adjacent ramps at their levels of intersection in the vertical projection. Also, as in the case of the two-system layouts, provision for entrance to or exit from each of the plurality of ramp systems may be made at floor landings or at a point along the ramps, depending upon the nature of the terrain and other factors.

As indicated, greater numbers of ramp systems may be employed to increase the number of alternative routes, to reduce the volume of traffic per route, and to decrease the necessary travel distance to parking spaces. To state a preferred general case involving n systems of ramps, the first system of ramps would communicate at one end of the building with the first floor level and with levels $1+an$ (i. e. for $n=3$ in Fig. 7, floors **1**, **4**, and **7**), and at the opposite end of the building with the basement and with floor levels an (floors **3** and **6**, for $n=3$), where a is a number in the series 0, 1, 2, 3, 4, etc. the second system of ramps would communicate at the one end of the building with the second floor and with levels $2+an$ (i. e. for $n=3$, floors **2** and **5**), and at the opposite end of the building with the first floor level and with levels $1+an$; and so on, until the nth system of ramps, which would communicate at the one end of the building with the basement and with floor levels an, and at the opposite end of the building with floor levels $an-1$ (i. e. for $n=3$, floors **2** and **5**). Thus, as compared with the conventional single-system ramp garage wherein all traffic must use landings at every floor level, the improved arrangement provides one nth the driving distances to parking rectangles; stated in other words, for a given driving distance from street level, n times the number of parking rectangles would be available.

In the above symbolism, it will be appreciated that a serves to identify the next level at which the ramps for a particular traffic-routing system will reach a landing at a particular end of the building. Thus, to consider the first system of ramps (in the 3-system garage of Fig. 7), at the left end of the building, for which the expression $1+an$ applies: at the ground or low level $a=0$ (first floor), at the next landing level $a=1$ (fourth floor), at the next landing level $a=2$ (seventh floor), and so on if the garage should have more floor levels than are shown.

It will be appreciated that in transcribing the above symbolism, zero or a negative result may sometimes be obtained. For example, in the case of the nth system of ramps (in the 3-system garage of Fig. 7), at the left end of the building, for which the expression an applies: at the low level $a=0$, and one obtains zero as a result; this answer will be understood to mean the first floor level below ground (i. e. the basement, or, rather, the first basement level, should there be more than one basement level). In the same garage, at the right end of the building, the expression $an-1$ applies, and if $a=0$, the result obtained is -1; this result will be understood to mean that the third system of the 3-route garage may terminate at a landing one level below the basement level (i. e. at a second basement) if one were to construct a garage including a second basement. Carrying this analysis one step further, it will be seen that, by substituting negative values for a in the expressions given above, one may readily derive further subbasement landing levels for each route system.

In the above descriptions, ramps and aisles have been discussed as comprising a single, one-way lane of traffic, accommodating preferably two rows of parking rectangles. It should be understood, however, that the invention also contemplates other arrangements, such as, for example, the employment of two or more lanes of traffic on a single ramp. In the latter case, four rows of parking rectangles (two for each traffic stream) could be laid out on each ramp, while the support columns could still provide common support for adjacent banks of ramps and obviate the need for further column support between the two or more lanes of the ramp.

Although preferred forms of the invention have been described in considerable detail, it should be understood that various modifications may be made without departure from the invention as defined in the claim which follows.

We claim:

In a garage structure, a plurality of substantially horizontal superposed landings at one side of the structure, a second plurality of substantially horizontal superposed landings at the opposite side of the structure and in substantially the same planes as said first-mentioned plurality of landings, a pair of spaced, parallel, inclined ramps connecting each of said landings at one side of the structure except the uppermost ones with a landing at the opposite side of the structure and in the next higher plane, a pair of spaced, parallel, inclined ramps connecting each of said landings at said opposite side except the uppermost ones with a landing at the opposite side of the structure and in the next higher plane, each of said aforementioned pairs of ramps being interfitted with an oppositely inclined pair, whereby each landing, with the exceptions of the lowermost and uppermost, is provided with a pair of lanes for ascending traffic and a pair of lanes for descending traffic, said ramps being substantially equally spaced in a horizontal direction from the ramp next adjacent thereto, at least one margin of each ramp having a free zigzag edge defined by lines meeting at angles and providing parking spaces for vehicles, and a series of vertical posts secured to said edge at the apices of such angles.

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