

DEMAND ESTIMATION APPARATUS

This invention relates to improvements in a demand estimation apparatus for estimating a demand such as the traffic volume of elevators in a building and the electric power load of a power station.

5 The traffic volume of elevators in a building, the electric power load of a power station, or the like (hereinbelow, termed "demand") fluctuate irregularly when closely observed within a period of one day, but present similar aspects for the same time zones when
10 observed over several days. In, for example, an office building, elevator passengers on their way to their office floors crowd on the ground floor during a short period of time in the morning arrival rush. In the first half of the lunch hour, many passengers go from
15 the office floors to a restaurant floor or the ground floor, while in the latter half of the lunch hour, many passengers go from the restaurant floor and the ground floor to the office floors. Finally, many passengers go
20 from the office floors to the ground floor at leaving time in the evening. The volume of traffic in the up direction and in the down direction are nearly equal in the daytime time zones other than those mentioned above, while the volume of traffic becomes very small throughout the night.

25 In order to deal with the traffice in the building changing in this manner by means of a limited number of

elevators, the elevators are usually operated under group supervision. When a hall call is registered anew, it is tentatively assigned to respective elevators, and the waiting times of all hall calls, the possibility of the full capacity of passengers, etc. are predicted to calculate service evaluation values for all the cases, from among which the appropriate elevator is selected. In order to execute such predictive calculations, traffic data peculiar to each respective building are required. For example, data on the number of passengers who get on and off the cage of each elevator at intermediate floors are required for predicting the possibility of full capacity. When such traffic data which changes every moment is stored each time, an enormous memory capacity is necessitated, which is not practical. Usually, the required memory size is reduced by dividing the operating period of time in one day into several time zones, wherein only the average traffic volume of the respective time zones are stored. After the completion of the building, however, there is a possibility that traffic data will change in accordance with changes in personnel organization in the building, and hence, it is difficult to obtain good traffic data with which the demand can be predicted accurately. For this reason, there has been thought out a system wherein traffic conditions in the building are continuously detected so as to sequentially improve the traffic data.

More specifically, the operating period of time in one day is divided into K time zones (hereinbelow, termed "sections"), and a time (hereinbelow, termed "boundary") by

which a section $k - 1$ and a section k are bounded is denoted by t_k ($K=2, 3, \dots, K$). Times t_1 and t_{K+1} are the starting time and end time of the elevator operation, respectively.

The average traffic volume $P_k(l)$ of the section k on the

5 l -th day is supposed to be given by the following equation (1):

$$P_k(l) = \frac{1}{t_{K+1} - t_K} \begin{bmatrix} x_k^u(l) \\ x_k^d(l) \\ x_k^u(l) \\ x_k^d(l) \end{bmatrix} \quad (1)$$

Here, $x_k^u(l)$ is a column vector of $F - 1$ dimensions (where F denotes the number of floors) the elements of which are the number of passengers to get on cages in the up direction at respective floors in the time zone k of the 10 l -th day. Similarly, $x_k^d(l)$, $y_k^u(l)$ and $y_k^d(l)$ are column vectors which indicate the number of passengers to get on the cages in the down direction, the number of passengers to get off the cages in the up direction and the number of 15 passengers to get off the cages in the down direction, respectively. The average traffic volume (hereinbelow, termed "average demand") $P_k(l)$ is measured by a passenger-number detector which utilizes load changes during the stoppage of the cages of the elevators and/or industrial 20 television, ultrasonic wave, or the like.

First, it will be considered to sequentially correct the representative value of the average demand $P_k(l)$ of each time zone in a case where the boundary t_k is fixed.

It is thought that the columns $P_k(1), P_k(2), \dots$ 25 of the average demands occurring daily will be distributed in the

vicinity of a certain representative value P_k . Since the magnitude of the representative value P_k is unknown, it needs to be estimated by any method. In this case, there is the possibility that the magnitude itself of the representative value P_k will change. The representative value is therefore predicted by taking a linear weighted average given in Equations (2) and (3) below and attaching more importance to the average demand $P_k(l)$ measured latest, than to the other average demands $P_k(1)$, $P_k(2)$, and $P_k(l-1)$.

$$\hat{P}_k(l) = (1-a)^l P_k(0) + \sum_{i=1}^l \lambda_i P_k(i) \quad (2)$$

$$\lambda_i = a(1-a)^{l-i} \quad (3)$$

Here, $\hat{P}_k(l)$ is the representative value which has been predicted from the average demands $P_k(1)$,, and $P_k(l)$ measured till the l -th day, and $P_k(0)$ is an initial value which is set to a suitable value and is set in advance. λ_i denotes the weight of the average demand $P_k(i)$ measured on the i -th day, and this weight changes depending upon a parameter a . More specifically, an increase in the value of the parameter a results in an estimation in which more importance is attached to the latest measured average demand $P_k(l)$ than to the other average demands $P_k(1)$,, and $P_k(l-1)$, and in which the predictive representative value $\hat{P}_k(l)$ quickly follows up the change of the representative value P_k . However, when the value of the parameter a is too large, it is feared that the predictive representative value will change too violently in a manner to be influenced by the random variation of daily data. Meanwhile, Equations (2) and (3) can be rewritten as follows:

$$\hat{P}_k(l) = (1-a)\hat{P}_k(l-1) + aP_k(l) \quad (4)$$

$$\hat{P}_k(0) = P_k(0) \quad (5)$$

In accordance with the above Equation (4), there is the advantage that the weighted average of Equation (2) can be calculated without storing the observation values $P_k(i)$ ($i = 1, 2, \dots, l-1$) of the average demands in the past.

However, granted that the foregoing representative value P_k ($k = 2, 3, \dots, K$) of the average demand of each time zone has been precisely estimated, the deviation thereof from the actual demand is feared to become large near the demarcating boundary t_k ($k = 2, 3, \dots, K$) when the boundary t_k itself is inappropriate. This large deviation brings about the disadvantage that the predicative calculations of the waiting times, the possibility of the full capacity, etc. become erroneous, so the elevators are not group-supervised as intended.

This invention has been made to improve the disadvantages described above, and has for its object to provide a demand estimation apparatus wherein the section calculated from the demand of one cycle is compared and calculated with the section set by the calculation before this one cycle to set the section of the next one cycle, whereby the demand can be estimated at high precision.

~~In order to achieve the above and other objects the present invention provides a demand estimation apparatus~~

The present invention provides demand estimation apparatus for estimating demand in respective time zones within successive cycles of a substantially cyclically fluctuating demand, wherein each cycle is divided into a
5 plurality of successive sections, and an estimation value of the demand in each section is found based on the measured demand in that section as time elapses, which apparatus comprises

first means for calculating appropriate boundary
10 times of, the time zones in one cycle on the basis of the actual demand in the said cycle,

and second means for calculating and setting actual boundary times of the time zones in the next cycle on the basis of the calculated appropriate boundary times
15 and of the previously calculated actual time zone boundary times of the said one cycle.

The present invention also provides a demand estimation apparatus wherein one cycle of a demand fluctuating substantially cyclically is divided into a
20 plurality of sections having predetermined durations and wherein an estimation value of the demand of ^{each} ~~the~~ section is found on the basis of a measured result of the demand in the section as the time elapses, which apparatus comprises:

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(a) demand estimation means for finding said estimation value from said demand of said one cycle and the estimation value of demand that was found prior to said cycle;

5 (b) first means for calculating appropriate boundary times of said sections on the basis of the demand of said one cycle; and

10 (c) second means for setting the boundary times of the sections of the next cycle on the basis of the boundary times of the sections set by the second means in said one cycle and the boundary times of the sections calculated by said first means.

The present invention will be further described with reference to the accompanying drawings in which:

Figure 1 is a demand diagram showing the variation in the traffic volume of an elevator;

15 Figure 2 is a block diagram showing an embodiment of a demand estimation apparatus according to the present invention;

Figure 3 is a diagram showing the content of RAM in Figure 2;

20 Figure 4 is a diagram showing the content of ROM in Figure 2;

Figure 5 is a diagram showing the general flow of programs;

25 Figure 6 is a diagram showing the flow of the operation of an initializing program in Figure 5;

Figure 7 is a diagram showing the flow of the operation of a demand calculating programs;

Figure 8 is a diagram showing the flow of the operation of an average demand estimating program; and

Figure 9 is a diagram showing the flow of the operation of a boundary setting programs.

DESCRIPTION OF THE PREFERRED EMBODIMENT

5 An embodiment of the present invention will now be described with reference to Figures 1 to 9.

Referring to Figure 1, there will be first described the outline of a procedure in the case where the boundary between respective sections is corrected by a demand
10 estimation apparatus according to this invention.

In the figure, A denotes an l -th demand curve, $t_1(l) - t_9(l)$ denote a demarcating boundary time on the l -th day preset by calculation before the l -th day, $t'_1(l) - t'_9(l)$ denote a demarcating boundary time of the appropriate section
15 as observed from the demand on the l -th day, and $P_1(l) - P_8(l)$ denoted an average demand on the l -th day between the section 1 and the section 8.

In this example, the demand has been detected by the previous calculation in the eight sections at the
20 boundary times of $t_1(l) - t_8(l)$ on the l -th day. Here, when the average demands in the respective sections are expressed by $P_1(l) - P_8(l)$, the representative values $\hat{P}_1(l) - \hat{P}_8(l)$ which have been predicted by the Equation (4) can be obtained as described above.

25 On the other hand, the section in which the demand has been detected cannot be always judged as being preferable.

For example, in case of the demand curve A, it is considered to be preferable that the boundary times are $t'_2(l) - t'_8(l)$. This corresponds to the case that the sections are set so that total demands in the respective sections become substantially constant. The section setting means can be considered in various ways in addition to the above, but it is essential to preferably grip the features of the demand curve A.

However, it is not appropriate to set the boundary time on the $(l+1)$ -th day to $t'_2(l) - t'_8(l)$ as they are. Because it is considered that the columns $t_k(1), t_k(2), \dots$ of the boundary time are irregular in the same manner that the columns $P_k(1), P_k(2), \dots$ of the average demand are irregular near the certain representative value P_k . Likewise, the boundary time can be predicted as follows:

$$\hat{t}_k(l) = (1-b)\hat{t}_k(l-1) + bt_k(l) \quad (6)$$

$$\hat{t}_k(0) = t_k(0) \quad (7)$$

Here, $\hat{t}_k(l)$ denotes the representative value of the boundary time predicted from the demand which has been measured till the l -th day, and $t_k(0)$ denotes an initial value, and b denotes a parameter in case of $0 < b < 1$. When this is applied to Figure 1, the boundary time of the section on the $(l+1)$ -th day becomes as the following equation:

$$t_k(l+1) = (1-b)t_k(l) + bt'_k(l) \quad (8)$$

When $b = 0.5$ is set, for example, the average time of $t_k(l)$ and $t'_k(l)$ becomes the boundary time of the section on the $(l+1)$ -th day.

It is simple to set the $t_1(l)$ and $t_9(l)$ to be fixed values, and when the interval between the $t_1(l)$ and $t_9(l)$ is set to be just one day, the $t_1(l)$ may be a demand having a small time, and may ordinarily be zero time at midnight. In this case, it naturally becomes $t_9(l) = t_1(l+1)$.

In this manner, the section can be suitably set, the demand can be accurately grasped, and the prediction can be accurate.

In Figure 2, numeral 1 designates clock means which produces a timing signal 1a each time the unit time DT (e.g., 5 minutes) lapses, numeral 2 control means which basically comprises an electronic computer such as micro-computer, wherein symbol 2A is an input circuit which is constructed of a converter for receiving an input, symbol 2B is a central processing unit (hereinbelow, termed "CPU"). symbol 2C is a random access memory (hereinbelow, termed "RAM") which stores data such as the operated results of the central processing unit 2B, symbol 2D is a read only memory (hereinbelow, termed "ROM") which stores programs and constant value data, and symbol 2E is an output circuit which is constructed of a converter for delivering signals from the CPU 2B. Numeral 3 designates a group supervisory system which group-supervises three elevator cages 4A, 4B and 4C in accordance with signals from the control means 2 and which can, for example, as disclosed in U. S. Patent No. 4,244,450, employ number-of-persons detection means indicated by symbols 5A, 5B and 5C which are respectively provided in the cages 4A, 4B and 4C and produce signals proportional to the number of persons. Symbols 6A, 6B and 6C

designate number of persons boarding calculation means
 for storing the minimum value of input signals when doors
 are open, subtracting the minimum value from the value of
 the input signal when the doors are closed and calculating
 5 the number of persons who have boarded the cages 4A, 4B and
 4C, as taught in e.g., U. S. Patent No. 4,044,860. Numeral
 7 designates addition means which adds the inputs A, B and C,
 cumulates the inputs D for the unit time DT, and outputs
 as the number of persons boarding signal 7a the cumulated
 10 value on the basis of a timing signal 1a and simultaneously
 starts the cumulating operation of the next time unit.

In Figures 3 and 4, symbol TIME indicates a time
 obtained from the timing signal 1a, symbols T(1) - T(9)
 boundaries expressed by times, symbols TA(2) - TA(8) temporary
 15 boundaries determined from the demand on that day, P(1) - P(8)
 average demands in the sections 1 - 8 respectively, PL(1) -
 PL(8) predictive average demands which correspond to the
 representative value $\hat{P}_k(l)$ in the sections 1 - 8 respectively
 (k=1 - 8), symbol LD a demand which corresponds to the number
 20 of persons boarding signal 7a, and symbols J - N counters
 used for variables which indicate the sections. These data
 are stored in the RAM(2C). Symbols T(1) - T(9), which are
 set at 0 (= 0: 00), 96 (= 8: 00), 108 (= 9: 00), 132 (= 11: 00),
 144 (= 12: 00), 156 (= 13: 00), 204 (= 16: 00), 216 (= 18: 00)
 25 and 288 (= 24: 00), respectively, P1 - P8 the initial values
 of the predictive average demands PL(1) - PL(8), which are set
 at 5, 80, 40, 60, 80, 30 and 5 (passengers/5 minutes),
 respectively, symbol SA a parameter corresponding to the
 parameter a in Equation (4) set at a value 0.2, and symbol SB

a parameter corresponding to the parameter b in Equation (6) set at a value 0.2. These data are stored in the ROM(2D).

In Figure 5, numeral 11 designates an initializing program for setting the initial values of various data, numeral 12 an input program which accepts signals from the input circuit 2A and sets them in the RAM 2C, numeral 13 a demand calculating program which calculates the average demands $P(1) - P(8)$ measured in the respective sections 1 - 8, numeral 14 an average demand estimating program which calculates the predictive average demands $PL(1) - PL(8)$ in the respective sections 1 - 8, numeral 15 a boundary setting program which corrects the boundaries $T(2) - T(8)$ of the respective sections 1 - 8, numeral 16 an output program which transmits the predictive average demands $PL(1) - PL(8)$ from the output circuit 2E; in Figure 6, numerals 21 - 23 are the operating sequences of the initializing program 11, in Figure 7, numerals 31 - 34 are the operating sequences of the demand calculating program 13, in Figure 8, numerals 41 - 45 are the operating sequences of the demand estimating program, and in Figure 9, numerals 51 - 72 are the operating sequences of the boundary setting program 15.

The operation of this embodiment of the demand estimation apparatus constructed as thus far described operates as follows.

The number-of-persons detection means 5A - 5C produce signals proportional to the number of persons who have gotten on the cages 4A - 4C, respectively, and the

calculation means 6A - 6C calculate the number of persons who have gotten on the cages 4A - 4C, respectively. The respective numbers of the persons who have gotten on the cages are added, whereupon the

5 signal 7a is produced, and sent to the input circuit 2A. Simultaneously therewith, the number of counts produced when the value 1 is counted every 5 minutes since a time 0 o'clock is provided as the timing signal 1a from the clock means 1, and it is inputted to the input
10 circuit 2A.

On the other hand, when the control means 2 is first connected to a power source, the initializing program 11 is actuated. More specifically, the initial values T1 - T4 are respectively set for the boundaries T(1) - T(9) at Step 21.
15 Subsequently, at Step 22, the initial values PL1 - PL8 are respectively set for the predictive average demands PL(1) - PL(8). Next, when the average demands P(1) - P(8) are reset to 0 at Step 23, the control flow shifts to the input program 12.

20 The input program 12 is a well-known program which feeds the input signal from the input circuit 2A into the RAM 2C. By way of example, when the time is 8 o'clock, the input program reads the value 96 from the input circuit 2A and shifts it so as to set the time TIME of the RAM 2C at 96.

25 Likewise, when the signal 7a is accepted, the value is set as the demand LD of the RAM 2C.

Next, the operations of the demand calculating program 13 will be explained. At Step 31, the counter J is set to 1. When the time TIME is larger than the boundary

time $T(J+1)$ at Step 31, the control flow proceeds to Step 33, at which the counter J is increased by 1, and the control flow returns again to Step 32. When the time $TIME$ is smaller than the boundary time $T(J+1)$, the control flow proceeds to Step 34. Here, the average demand $P(J)$ of the section J is corrected by the use of the demand LD measured anew, so as to increase to the amount of the demand per unit time DT as denoted by the up $LD / [T(J+1) - T(J)]$. In this manner, the demand of the section which corresponds to the time is added and calculated so as to calculate the average demand $P(J)$ per unit time DT .

Next, the operations of the average demand estimating program 14 will be explained. Only when the time $TIME$ arrives at the boundary $T(9)$ which is the end time of the section 8 indicated by Step 41, the following steps 42 - 45 are executed. After the counter J is initialized to 1 at Step 42, the predictive average demand $PL(J)$ calculated till the preceding day is multiplied by $(1-SA)$ and is added to the average demand $P(J)$ just observed on the particular day multiplied by SA , to set a predictive average demand $PL(J)$ anew. The value of the counter J is judged at Step 44, and when it is smaller than 8, the counter J is increased by 1 at Step 45, and the calculation of Step 43 is repeated. Then when the calculation is executed till the section 8, $J=3$ is established, whereupon the program is shifted to the next.

Next, the operations of the boundary setting program 15 will be explained. When, at Step 51, the time $TIME$ has reached the boundary $T(9)$ being the end time of the section

8, the control flow proceeds to Step 52, at which time the counter J is set to 1. Subsequently, at Step 53, the counter K is set to 0. At Step 54, the total demand of the section J is calculated by multiplying the average demand per unit time by the length of the section. At Steps 55 and 56, the Step 54 is executed until the counter J becomes 8, and the above calculation is cumulated in the counter K. Therefore, while the control flow proceeds from Step 55 to Step 57, the counter J calculates the sum of the total demand from 1 to 8 and the counter K accordingly calculates the total demand in one day. At Step 57, the value is divided by 8, and is again applied to the counter K. More specifically, the average section total demand is applied to the counter K. After the counters J, L, M and N are respectively set to 1, 2, 0 and 1 at Step 58, the control flow proceeds to Step 59, and the average demand $P(J)$ of the section J is added in the counter M. Then, when the counter M has not yet arrived at the average section total demand K at Step 60, the counter N is increased by 1 at Step 65, and the control flow returns to Step 59 until the counter N arrives at the boundary time $T(J+1)$ at Step 66. When the counter M has arrived at the average section total demand K at Step 60, the control flow proceeds from Step 60 to Step 61, and the value of the counter N is applied as the temporary boundary time $TA(L)$. Since the counter L is initially set to 2 at Step 58, the temporary boundary time $TA(2)$ is thus determined in this fashion. When the counter L is smaller than 8 at Step 62, the counter L is increased by 1 at Step 63. Then, the counter K is subtracted from

the counter M at Step 64, and the counter N is increased by 1 at Step 65. When, at Step 66, the counter N has arrived at the boundary time $T(J+1)$, the counter J is increased by 1 at Step 67, and the control flow returns to Step 59. In this manner, the average demand $P(J)$ of the next section is added to the counter M at Step 59.

In this manner, when the time N has arrived at the boundary time $T(J+1)$ so far, the average demand $P(J)$ of the next section is added. When the cumulation of the average demand $P(J)$ has arrived at the average section total demand, the time N which corresponds to it is set as the temporary boundary time $TA(L)$. When $L=8$ is established, all have been decided (since the $TA(9)$ is fixed at 24 o'clock), and the control flow accordingly proceeds from Step 62 to Step 68.

After, at Step 68, the counter J is set to 1, the boundary time is corrected at Step 69. More specifically, the sum of the boundary time $T(J)$ so far multiplied by $(1-SB)$ and the temporary boundary time $TA(J)$ multiplied by SB is applied to a new boundary time $T(J)$. For example, it is assumed that the boundary time $TA(J)$ is 101 (which corresponds to 8: 25) and the boundary time $T(J)$ so far is 96 (which corresponds to 8: 00), the new boundary time $T(J)$ is, since $SB=0.2$ is established:

$$T(J) = (1-0.2) \times 96 + 0.2 \times 101 = 97$$

Thus, the boundary time is displaced by 5 minutes. After, at Step 70, the average demand $P(J)$ is reset to 0 for the calculation of the next day, Steps 69 and 70 are repeated till the counter J becomes 8 at Steps 71 and 72.

The output program 16 produces the predictive average demand $PL(J)$ of the respective sections divided by

the boundary times obtained in this manner to the group supervisory system 3, which suitably group-supervises on the basis of the data, but the detail will be omitted.

In this example, the unit time DT has been set at 5 minutes, and the parameters a and b at 0.2. However, they are not restrictive, and may respectively be set at values which conform with the content, properties, fluctuating magnitudes, etc. of the demand to be estimated.

In the above embodiments, the temporary boundary time $TA(J)$ has been set at the time for dividing equally the traffic demand on one day, but they are not restrictive.

Further, the sum of the number of persons boarding on all halls has been set as traffic demand, but it may be calculated and estimated at every floor or every direction, or the number of calls may be employed as the factor of the traffic demand.

Furthermore, it is to be understood from the foregoing embodiment that the invention is not restricted to the case of the estimating the traffic volume of elevators, but that it is also applicable to cases of estimating various demands such as electric power demand and water quantity demand.

Moreover, the new boundary time $T(J)$ is not necessary to obtain by the Equation (8), but the temporary boundary time $TA(J)$ is compared with the boundary time $T(J)$ so far, and the new boundary time $T(J)$ can be obtained with simple means for moving it toward the temporary boundary time $TA(J)$ in response to the difference. For example, when the temporary time $TA(J)$ is different from the boundary

time $T(J)$ so far longer than 5 minutes, the boundary time $T(J)$ may be moved always only for 5 minutes. Further, the boundary time $T(J)$ is not moved on every day, but is moved by the result so far at once per week.

5 As set forth above, in the present invention, the section set by predetermined conditions from the demand of one cycle is compared and calculated by the section set by the calculation till the previous cycle, thereby setting the section of the next one cycle. Therefore, the boundary
10 time can be suitably altered, and the demand in the vicinity of the boundary can be precisely estimated.

CLAIMS:

1. Demand estimation apparatus for estimating demand in respective time zones within successive cycles of a substantially cyclically fluctuating demand, wherein each cycle is divided into a plurality of successive sections, and an estimation value of the demand in each section is found based on the measured demand in that section as time elapses, which apparatus comprises

first means for calculating appropriate boundary times of, the time zones in one cycle on the basis of the actual demand in the said cycle,

and second means for calculating and setting actual boundary times of the time zones in the next cycle on the basis of the calculated appropriate boundary times and of the previously calculated actual time zone boundary times of the said one cycle.

2. A demand estimation apparatus according to claim 1, wherein said second means shifts the boundary times of said respective sections from the actual values set by calculation before said one cycle, towards the appropriate boundary times of said respective sections of said one cycle calculated by said first means section by section by a predetermined time.



3. A demand estimation apparatus according to claim 2, wherein said second means varies said predetermined time in response to the difference between the boundary time set before said one cycle and the actual boundary time
5 calculated by said first means.

4. A demand estimation apparatus according to claim 3, wherein said second means calculates the boundary times of the sections for the next cycle by applying weights to the boundary times calculated by said first means and
10 to the actual boundary times set before said one cycle.

5. A demand estimation apparatus according to any preceding claim further comprising: time means for generating regular periodic timing signals, and addition means for producing a demand count for each period
15 whenever the timing signal is generated, wherein said first means sets said boundary time on the basis of the output of said addition means.

6. A demand estimation apparatus according to claim 5, wherein said addition means accumulates the number of
20 persons boarding an elevator cage, and the said number is detected by a number-of-persons detection means provided on said cage.



7. A demand estimation apparatus according to claim 5 or 6, wherein when said time means generates the timing signal, said addition means produces a demand count for the preceding period, and is reset and starts counting the demand for the next period.

8. A demand estimation apparatus according to any preceding claim wherein said first means sets said boundary times of the respective sections so that the total demands of said respective sections become equal to each other.

9. A demand estimation apparatus according to claim 8, wherein said first means calculates the average section total demand by dividing the total demand for one cycle by the number of said sections, and sets said boundary times so that the total demands of said respective sections become equal to said average section total demand.

10. A demand estimation apparatus wherein one cycle of a demand fluctuating substantially cyclically is divided into a plurality of sections having predetermined durations and wherein an estimation value of the demand of ^{each} ~~the~~ section is found on the basis of a measured result of the demand in the section as the time elapses, which apparatus comprises:



(a) demand estimation means for finding said estimation value from said demand of said one cycle and the estimation value of demand that was found prior to said cycle;

(b) first means for calculating appropriate boundary times of said sections on the basis of the demand of said one cycle; and

(c) second means for setting the boundary times of the sections of the next cycle on the basis of the boundary times of the sections set by the second means in said one cycle and the boundary times of the sections calculated by said first means.

11. A demand estimation apparatus according to claim 10, wherein said demand estimation means finds the estimation value by giving more importance to the demand that is measured latest than to the demands measured earlier.

12. A demand estimation apparatus constructed and operative substantially as herein described with reference to the accompanying drawings.

