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(54) **A system for managing a lighting plant by radio-frequency networks**

Vervaltung eines Kabellosse Beleuchtungsnetzwerk

System de gestion d'un complex luminaire à l'aide d'un réseau à radio-fréquence

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Description

[0001] The present invention relates to the technical field regarding the management of a lighting plant, with particular reference to management by radio-frequency networks.

[0002] As known, in the case of traditional mean-high power lighting plants, loads are preferably connected with one another in series, so as to define a so-called load mesh.

[0003] Electric loads can be connected in series with the aid of corresponding coupling transformers having the corresponding primary coil in series, in this case, to the same load mesh.

[0004] Starting from a known power supply, based on the number of expected loads, this allows to impose the desired current intensity in the power feeding mesh and consequently, in the loads.

[0005] Beside the traditional power circuit for load feeding, there is often a subsidiary local circuitry capable of managing single or groups of loads as regards the ON/OFF operating status check and the physical integrity of the load itself. Such circuitry must be capable of communicating with suitable control units.

[0006] This requires a considerable extension of electric cables that may undergo interference and/or noise, which could impair the correct management of the same lighting plant.

[0007] As an alternative, electric cables can be replaced by optical fibres which, however, imply high costs and problems relating to the connection reliability in case of water and dirt.

[0008] A further solution consists in using waves conveyed onto the load mesh cables; however, this is very difficult to implement due to the presence of the coupling transformer inductance.

[0009] An object of the present invention is to propose a system for managing a lighting plant, wherein the local circuitry is managed by radio-frequency networks, which should ensure a high reliability and allow optimum operation of the same both as regards the activation and/or deactivation of each load, and as regards the ON/OFF operating status and integrity check.

[0010] Another object of the present invention is to minimise electric circuitry of the control network managing said lighting plant, allowing at the same time easy extensions of the same system without affecting its functionality and versatility.

[0011] A further object of the invention is to propose a technical solution of simple design, relatively little cost, capable of controlling the characteristic parameters of the loads and of integrating with pre-existing management and control systems, allowing a considerable extension of the same.

[0012] The above objects are achieved according to the contents of the claims.

[0013] The characteristic features of the present invention will be pointed out in the following description of

a preferred, but not limiting embodiment, with reference to the enclosed drawings, in which:

- Figure 1 is a schematic plan view of a lighting plant managed by the proposed system;
- Figure 2 is a block diagram, which defines the operation of the proposed system.

[0014] With reference to the enclosed drawings, reference A is used to denote the area on which a lighting plant extends, essentially consisting of a plurality of n groups of m loads each (L1l, ..., L1m), ..., (Lnl, ..., Lnm) determining respective elementary areas A1, ..., An on which the same groups of loads are properly distributed (Figure 1).

[0015] Such lighting plant, basically consisting of lamps, for example connected in series to define forced current circuits, is powered and managed by an earth control network, of type known in the field, capable of feeding each load Lji.

[0016] Such control network allows activating and/or deactivating at any time each load (Ljl, ..., Ljm) of the generic jth group using control members (not shown) of known type, as well as checking their ON/OFF operating status and optionally testing their circuit integrity by proper tests.

[0017] It is understood that each load Lji comprises a relevant circuit group (not shown for clarity) provided with the local circuitry, of known type, needed to enable and/or disable the same, to check the above operating status and the circuit integrity of the same.

[0018] Reference W indicates a co-ordination control unit, arranged in the interested area A, preferably in barycentric position with respect to the elementary areas Aj, intended to interact through radio-frequencies with each load (Ljl, ..., Ljm) present in the same elementary area Aj (j = 1, ..., n).

[0019] Such co-ordination control unit W interacts with the above loads (Ljl, ..., Ljm) directly or through support control units (Wl, ..., Wz), suitably arranged onto the extended area A, in turn interacting through radio-frequencies with at least one load Lji (i = 1, ..., m) of each jth group (Ljl, ..., Ljm) (Figure 2).

[0020] In this way it is possible to manage and/or control loads (Ljl, ..., Ljm) so as to distribute them on very extended areas A without imposing the use of signals characterised by excessively high amplitudes and/or powers to the co-ordination control unit W.

[0021] As a consequence, each load Lji can interact through radio-frequencies both with the co-ordination control unit W and, optionally, with a support control unit Wj provided in the proximity of the area Aj to which the same load Lji belongs.

[0022] Therefore, each load Lji is capable of communicating by means of radio signals its ON/OFF status and its circuit integrity to the co-ordination W and support Wj control units, obtained using its circuit group.

[0023] Using data and/or information transmission through radio-frequency networks it is possible to avoid the circuit connections needed to implement metal connections between loads L_{ji} and the co-ordination W and/or support W_j control units.

[0024] By providing a microprocessor device (not shown) for each load L_{ji} , for example embedded in the layer of insulating resin of the same load L_{ji} , it is also possible to perform a more sophisticated management of the same load L_{ji} , optionally performing feedback checks on the current and/or voltage to keep their values substantially constant independently of the current impressed in the load mesh, whose feeder can thereby be substantially simplified.

[0025] As a consequence, such microprocessor device manages and controls the above circuit group, associated to each load L_{ji} , comprising the local circuitry that enables and/or disables it, and checks the operating status and the circuit integrity of the same.

[0026] The above is particularly interesting in the cases of enlargements and/or updating of pre-existing lighting plants. In fact in these cases, it is possible to insert additional loads L_{ji} without interrupting service in the pre-existing loads L_{ji} .

[0027] Checks on the operating status and the circuit integrity of each load L_{ji} , as well as any data and/or information about it, are processed by the connected microprocessor device and communicated by means of radio signals to the co-ordination W and/or support W_j control units.

[0028] During working of the lighting plant, it is possible to activate and/or deactivate, by remote control, the desired loads L_{ji} , in relation to the command signals coming from the co-ordination W and/or support W_j control units.

[0029] Likewise, it is possible to check, always with the aid of corresponding circuit groups connected to each load L_{ji} , the operative ON/OFF status thereof and to perform predetermined qualifications tests by transmitting the results by radio signals.

[0030] The proposed managing system is particularly useful in public lighting plants and the systems for lighting the airports, where the areas A are very large and the maintenance service must be rapid and preferably limited to indispensable interventions.

[0031] A particularly appreciated and useful advantage results from the possibility to manage a lighting plant which can be extended and/or modernized without interrupting the service or changing in any way the working and versatility thereof.

[0032] In the case of the lighting plants being designed, the possibility to provide radio-frequency communication systems between each load L_{ji} and the co-ordination W and support W_j control units allows to reduce and simplify considerably the circuitry of the control network, thus assuring a significant reduction of installation costs and a particularly rapid construction of the system.

[0033] Consequently, the proposed system for managing a lighting plant by radio-frequency networks ensures a high reliability and allows optimum operation of the same both as regards the activation and/or deactivation of each load and as regards the ON/OFF operating status and integrity check.

[0034] The above advantages have been achieved by a technical solution of simple design and reducing considerably the working costs of the lighting plant.

Claims

1. System for managing a lighting plant by radio-frequency networks, said lighting plant being powered and managed by an land control network, including a plurality of groups of loads (L_{j1} , ..., L_{jm}) ($j = 1, \dots, n$), distributed in corresponding elementary areas (A_j) ($j = 1, \dots, n$), **characterized in that** it includes at least one co-ordination control unit (W), which is situated near said elementary areas (A_j) and interacts with at least one load (L_{ji} ; $i = 1, \dots, m$) of a related (j -th; $j = 1, \dots, n$) group through said radio-frequencies networks.
2. Managing system, according to claim 1, **characterized in that** it includes at least one subsidiary control unit (W_j) situated near one of said elementary areas (A_j) and interacting with said co-ordination control unit (W) and at least one load (L_{ji} ; $i = 1, \dots, m$) of a related (j -th; $j = 1, \dots, n$) group through said radio-frequencies networks.
3. Managing system, according to claim 1 or 2, **characterized in that** it includes a microprocessor device, which is associated to at least one load (L_{ji} ; $i = 1, \dots, m$) and interacts with at least said co-ordination control unit (W) and manages and controls autonomously the load (L_{ji}).
4. Managing system, according to claim 1, **characterized in that** said co-ordination control unit (W) interacts with said load (L_{ji}), so as to enable and disables it, and to check the operating status and the circuit integrity thereof.
5. Managing system, according to claim 2, **characterized in that** said support control unit (W_j) interacts with said load (L_{ji}), so as to enable and disables it, and to check the operating status and the circuit integrity thereof.
6. Managing system, according to claim 1 or 4, **characterized in that** said co-ordination control unit (W) interacts with each load (L_{j1} , ..., L_{jm}) of said (j -th; $j = 1, \dots, n$) related group.
7. Managing system, according to claim 2 or 5, **char-**

acterized in that said support control unit (Wj) interacts with each load (Ljl, ..., Ljm) of said (jth; = 1, ..., n) related group.

8. Managing system, according to claim 3, **characterized in that** said microprocessor device enables/disables corresponding load (Lji) of each (jth) group and checks the operating status ON/OFF and the circuit integrity of the same. 5
9. Managing system, according to claim 3 or 8, **characterized in that** said microprocessor device keeps substantially constant the current of said load (Lji). 10
10. Managing system, according to claim 2, **characterized in that** it includes a plurality of support control units (Wj; j = 1, ..., z), each of which is arranged near said elementary areas (Aj) and interacts with at least one load (Lji; i = 1, ..., m) of the related (jth; j = 1, ..., n) group. 15
11. Managing system, according to any of the previous claims, **characterized in that** said lighting plant is a plant for lighting airports. 20
12. Managing system, according to any of the previous claims, **characterized in that** said lighting plant is a public lighting plant. 25

Patentansprüche

1. Vorrichtung zur Steuerung eines Beleuchtungsnetzwerkes mittels eines Hochfrequenznetzwerkes, wobei das besagte Beleuchtungsnetzwerk durch ein bodengebundenes Kontrollnetzwerk versorgt und gesteuert wird, mit einer Anzahl von Lastgruppen (Ljl, ..., Ljm) gehandhabt (j = 1, ..., n), die in zugeordnete elementare Bereiche (Aj) (j = 1, ..., n) verteilt sind, **dadurch gekennzeichnet, daß** sie wenigstens eine Koordinierungssteuereinheit (W) umfaßt, die in der Nähe der besagten elementaren Bereichen (Aj) angeordnet ist und die mit wenigstens einer Last (Lji; i = 1, ..., m) aus einer zugeordneten (j-ten; j = 1, ..., n) Gruppe über die besagten Hochfrequenznetze zusammenwirkt. 35
2. Steuerungsvorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, daß** sie wenigstens eine Tochtersteuereinheit (Wj) umfaßt, die in der Nähe eines der besagten elementaren Bereiche (Aj) angeordnet ist und die mit der besagten Koordinierungssteuereinheit (W) sowie mit wenigstens einer Last (Lji; i = 1, ..., m) aus einer zugeordneten (j-ten; j = 1, ..., n) Gruppe über die besagten Hochfrequenznetze zusammenwirkt. 40

3. Steuerungsvorrichtung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** sie eine Mikroprozessoreinheit umfaßt, die wenigstens einer Last (Lji; i = 1, ..., m) zugeordnet ist und die mit wenigstens der besagten Koordinierungssteuereinheit (W) zusammenwirkt und die autonom die Last (Lji) ansteuert. 45
4. Steuerungsvorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, daß** die besagte Koordinierungssteuereinheit (W) mit der besagten Last (Lji) derart zusammenwirkt, daß sie diese ein- und ausschaltet und deren Funktionsstatus und Funktionstüchtigkeit überprüft. 10
5. Steuerungsvorrichtung gemäß Anspruch 2, **dadurch gekennzeichnet, daß** die besagte Tochtersteuereinheit (Wj) mit der besagten Last (Lji) derart zusammenwirkt, daß sie diese ein- und ausschaltet und deren Funktionsstatus und Funktionstüchtigkeit überprüft. 15
6. Steuerungsvorrichtung gemäß Anspruch 1 oder 4, **dadurch gekennzeichnet, daß** die besagte Koordinierungssteuereinheit (W) mit jeder Last (Lji; i = 1, ..., m) aus einer zugeordneten (j-ten; j = 1, ..., n) Gruppe zusammenwirkt. 20
7. Steuerungsvorrichtung gemäß Anspruch 2 oder 5, **dadurch gekennzeichnet, daß** die besagte Tochtersteuereinheit (Wj) mit jeder Last (Lji; i = 1, ..., m) aus einer zugeordneten (j-ten; j = 1, ..., n) Gruppe zusammenwirkt. 25
8. Steuerungsvorrichtung gemäß Anspruch 3, **dadurch gekennzeichnet, daß** die besagte Mikroprozessoreinheit eine zugeordnete Last (Lji) aus einer zugeordneten (j-ten) Gruppe ein-/ausschaltet und deren Funktionsstatus EIN/AUS und Funktionstüchtigkeit überprüft. 30
9. Steuerungsvorrichtung gemäß Anspruch 5 oder 8, **dadurch gekennzeichnet, daß** die besagte Mikroprozessoreinheit den Strom der besagten Last (Lji) im wesentlichen konstant hält. 35
10. Steuerungsvorrichtung gemäß Anspruch 2, **dadurch gekennzeichnet, daß** sie eine Anzahl von Tochtersteuereinheiten (Wj; j = 1, ..., z) umfaßt, die in der Nähe der besagten elementaren Bereiche (Aj) angeordnet sind und die mit wenigstens einer Last (Lji; i = 1, ..., m) aus der zugeordneten (j-ten; j = 1, ..., n) Gruppe zusammenwirkt. 40
11. Steuerungsvorrichtung gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** das besagte Beleuchtungsnetzwerk ein Netzwerk für die Beleuchtung von Flughäfen ist. 45

12. Steuerungsvorrichtung gemäß einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, daß** das besagte Beleuchtungsnetzwerk ein Netzwerk für die öffentliche Beleuchtung ist.

Revendications

1. Système de gestion d'un complexe luminaire à l'aide des réseaux de radio-fréquence, ledit complexe luminaire étant alimenté et géré par un réseau de commande terrestre, comprenant une pluralité de groupes de charges (L_{ji} , ..., L_{jm}) ($j = 1, \dots, n$), distribués dans des zones élémentaires correspondantes (A_j) ($j = 1, \dots, n$), **caractérisé en ce qu'il** comprend au moins une unité de commande de coordination (W), qui est située près desdites zones élémentaires (A_j) et interagit avec au moins une charge (L_{ji} ; $i = 1, \dots, m$) d'un groupe (j^{th} ; $j = 1, \dots, n$) associé au travers desdits réseaux de radiofréquence. 10
2. Système de gestion selon la revendication 1, **caractérisé en ce qu'il** comprend au moins une unité de contrôle secondaire (W_j) située près de l'une desdites zones élémentaires (A_j) et interagissant avec ladite unité de commande de coordination (W) et au moins une charge (L_{ji} ; $i = 1, \dots, m$) d'un groupe j^{th} ; $j = 1, \dots, n$) associé au travers desdits réseaux de radiofréquence. 15
3. Système de gestion selon la revendication 1 ou 2, **caractérisé en ce qu'il** comprend un dispositif microprocesseur, qui est associé à au moins une charge (L_{ji} ; $i = 1, \dots, m$) et interagit avec au moins ladite unité de commande de coordination (W) et gère et commande de manière autonome la charge (L_{ji}). 20
4. Système de gestion selon la revendication 1, **caractérisé en ce que** ladite unité de commande de coordination (W) interagit avec ladite charge (L_{ji}), de façon à l'activer et à la désactiver, et à vérifier l'état de fonctionnement et l'intégrité du circuit de celle-ci. 25
5. Système de gestion selon la revendication 2, **caractérisé en ce que** ladite unité de commande de soutien (W_j) interagit avec ladite charge (L_{ji}), de façon à l'activer et à la désactiver, et à vérifier l'état de fonctionnement et l'intégrité du circuit de celle-ci. 30
6. Système de gestion selon la revendication 1 ou 4, **caractérisé en ce que** ladite unité de commande de coordination (W) interagit avec chaque charge ($L_{j1}, \dots, L_{jm}$) dudit groupe (j^{th} ; $j = 1, \dots, n$) associé. 35
7. Système de gestion selon la revendication 2 ou 5, **caractérisé en ce que** ladite unité de commande 40

de support (W_j) interagit avec chaque charge ($L_{j1}, \dots, L_{jm}$) dudit groupe (j^{th} ; $j = 1, \dots, n$) associé.

8. Système de gestion selon la revendication 3, **caractérisé en ce que** ledit dispositif microprocesseur active/désactive la charge correspondante (L_{ji}) de chaque groupe (j^{th}) et vérifie l'état de fonctionnement MARCHE/ARRET et l'intégrité du circuit de celle-ci. 45
9. Système de gestion selon la revendication 3 ou 8, **caractérisé en ce que** ledit dispositif microprocesseur maintient sensiblement constant le courant de ladite charge (L_{ji}). 50
10. Système de gestion selon la revendication 2, **caractérisé en ce qu'il** comprend une pluralité d'unités de contrôle de soutien (W_j ; $j = 1, \dots, z$), chacune d'elles étant disposée à proximité desdites zones élémentaires (A_j) et interagissant avec-au moins une charge (L_{ji} ; $i = 1, \dots, m$) du groupe (j^{th} ; $j = 1, \dots, n$) associé. 55
11. Système de gestion selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit complexe luminaire est un complexe pour éclairer les aéroports.
12. Système de gestion selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit complexe luminaire est un complexe luminaire public.

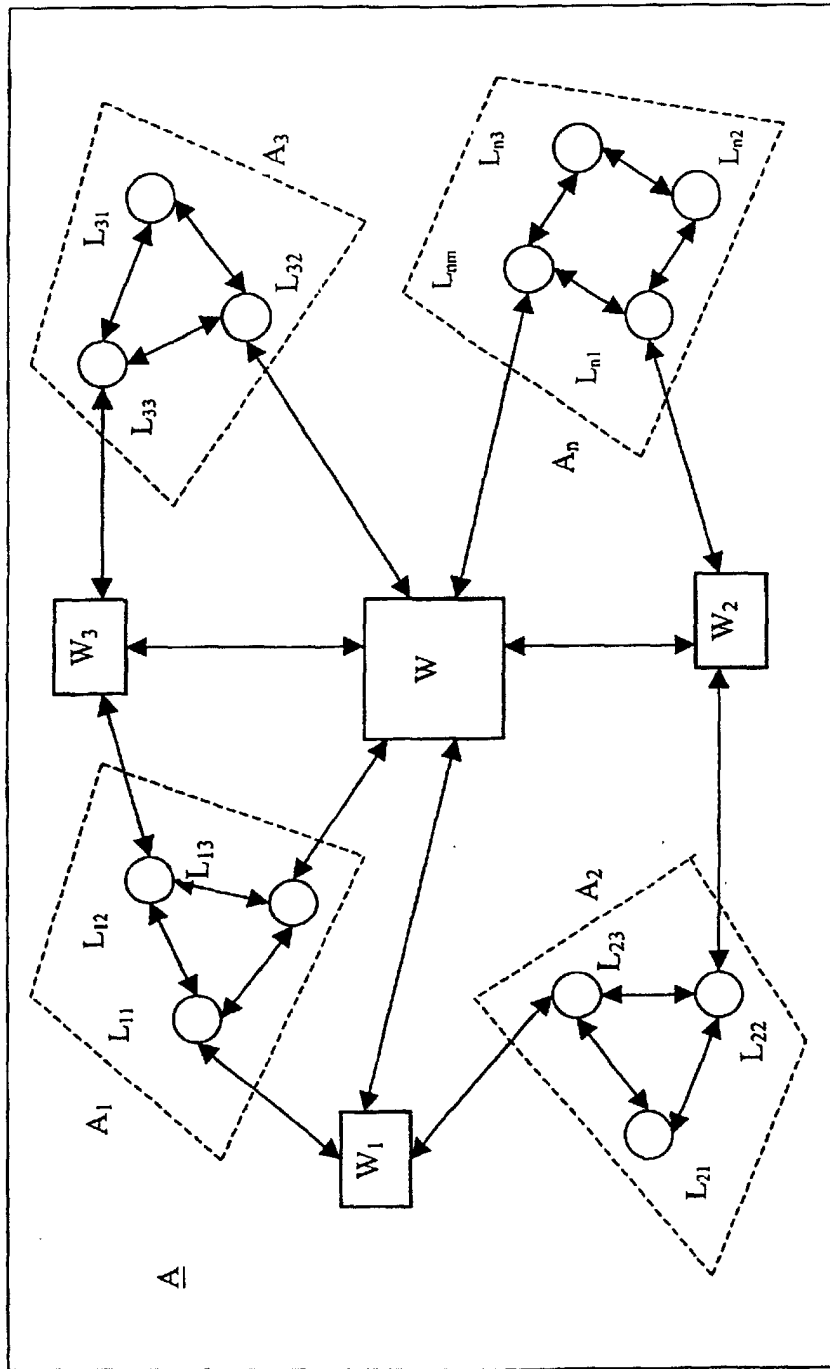


FIG. 1

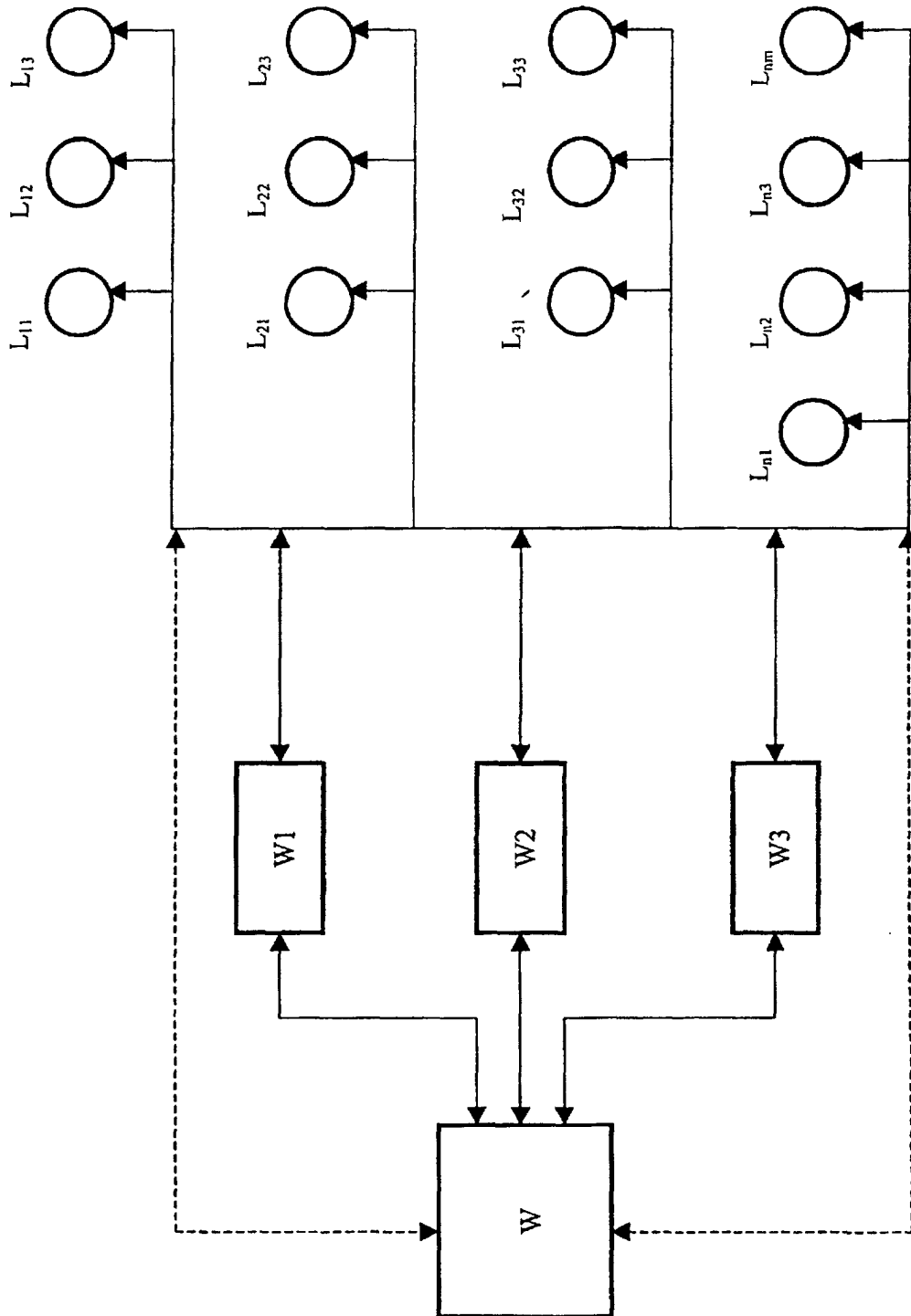


FIG. 2