United States Patent

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[54] **STRUCTURE SECURITY ALARM**
4 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **340/273,**
340/258 C, 340/274 R, 317/246
[51] **Int. Cl.** **G08b 13/26**
[50] **Field of Search** 340/273,
274, 258 C, 276; 256/10; 49/50; 109/42; 317/246,
242

[56] **References Cited**

UNITED STATES PATENTS

1,027,679	5/1912	Williams et al.	42/109 X
2,374,139	4/1945	Schriner	340/273 X
2,646,559	7/1953	Nutzler	340/258 C
3,324,647	6/1967	Jedynak	317/246 X
248,742	10/1881	Henck, Jr.	317/242
1,824,806	9/1931	Dubilier	317/261
2,398,088	4/1946	Ehlers et al.	317/261 X
2,640,975	6/1953	Roe et al.	340/258 X
3,508,239	4/1970	Fontaine	340/276 X

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ABSTRACT: A window grill comprises an assembly of tubular metallic grill elements, forming a first capacitor electrode, and a system of interconnected metal rods supported within the grill elements in spaced relation thereto, the rods forming a second capacitor electrode. Deformation of the grill results in a change of capacitance which may be detected by a capacitance-responsive device.

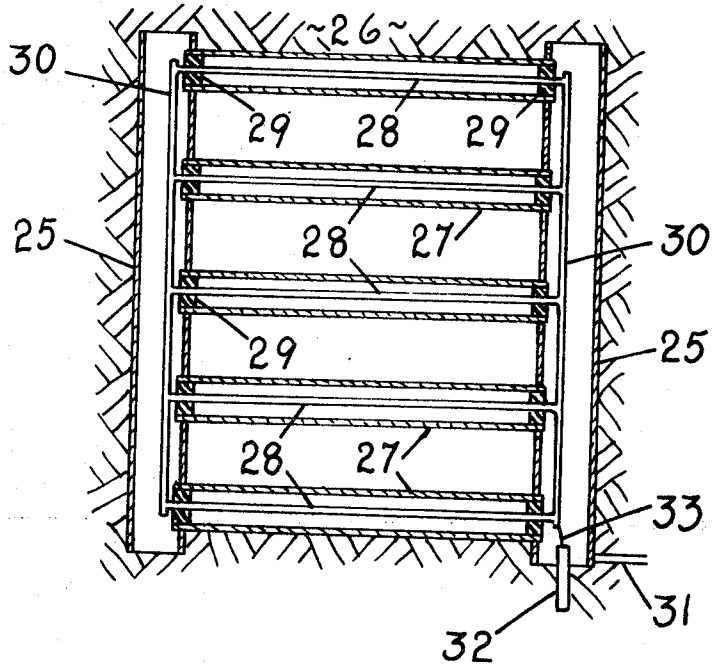
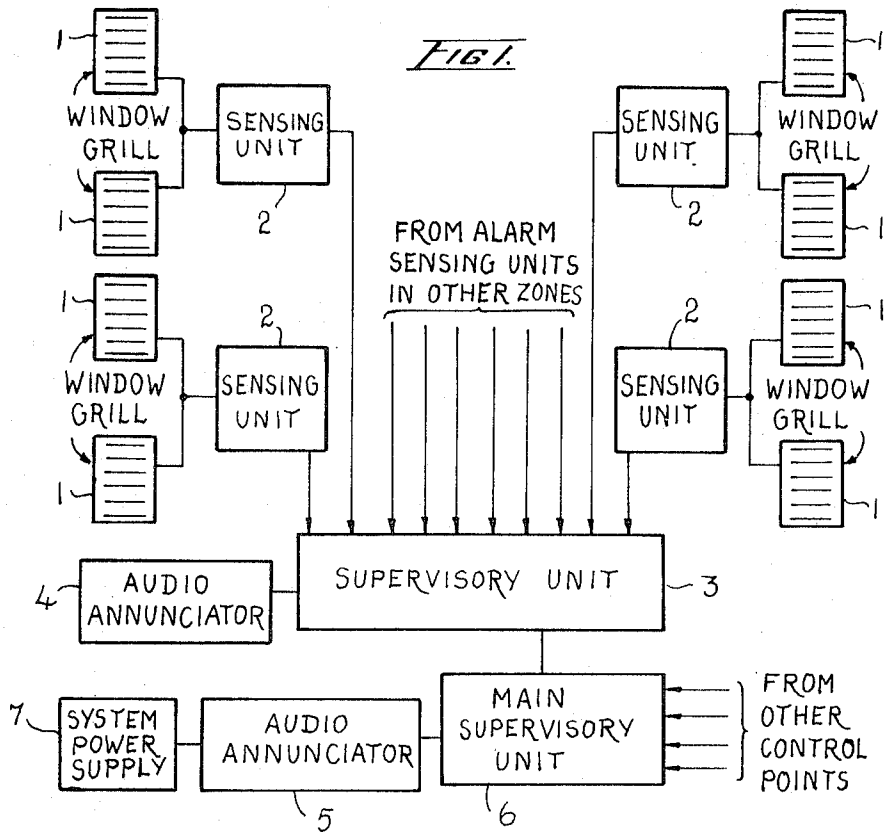


FIG 1.



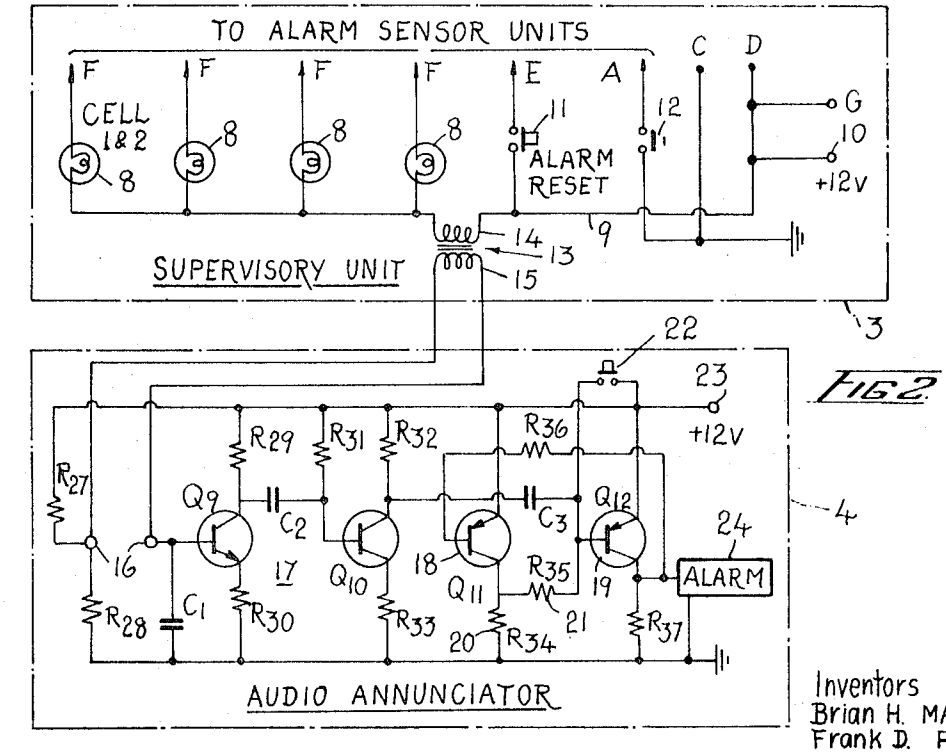
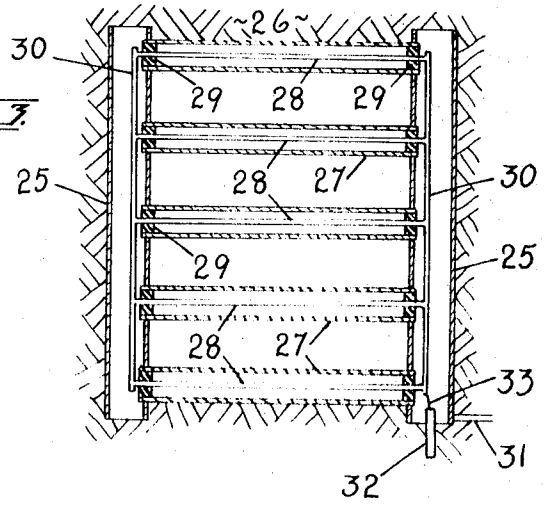


FIG 2.

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FIG. 3.



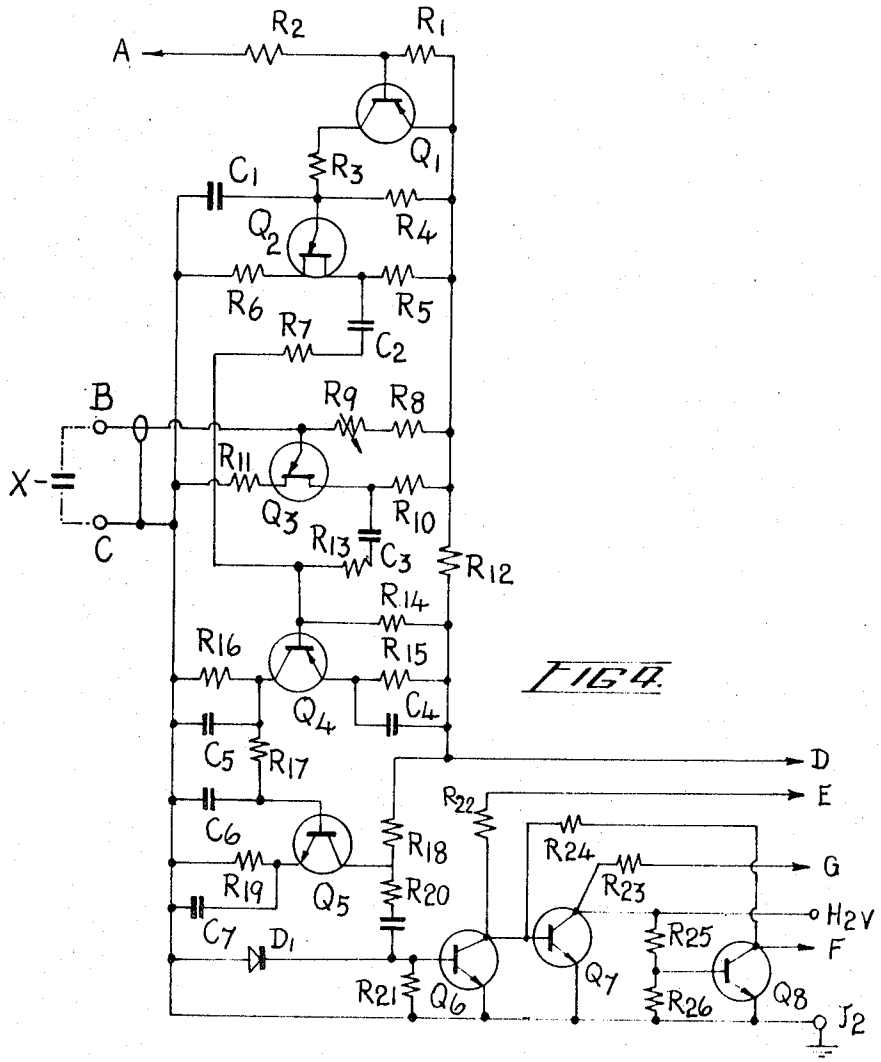


FIG 4.

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STRUCTURE SECURITY ALARM

CROSS REFERENCE TO RELATED APPLICATIONS

The invention is described in the context of a jail security system. Components of the system are described and claimed in our copending patent applications Ser. Nos. 747,343, now abandoned, and Ser. No. 747,391, now abandoned, filed concurrently herewith on July 24, 1968.

BACKGROUND OF THE INVENTION

This invention relates to window grills of the kind for use in prison cells, strongrooms and other enclosures where unauthorized entry or egress is to be prevented.

Hitherto the solution to the problem of providing security at jail windows has relied on the physical strength of metal rods or bars forming grates across the windows. The security of such structures has been lessened by modern mechanical cutting methods, in spite of the various hardened steels which are now available for the purpose. In order to detect attempts to attack the rods or bars of such a grill, electric alarm systems are available to provide an alarm at a remote point when the bars of the grill are attacked. The alarm systems usually include conductor wires embedded in the bars of the grill and rely upon the detection of a current interruption when a wire is severed. Such systems can easily be compromised, as a rule, by the well known procedure of short circuiting the conductors before they are severed.

In an effort to defeat attempts to short circuit the conductors, sophisticated versions of this type of alarm system have been proposed, but these are generally cumbersome, unreliable and expensive.

Another known type of alarm system uses light beams transmitted axially through the bars of the grill, and provides means for detecting the interruption of a light beam. Such a system suffers from the disadvantage of very high cost.

Simple sound detectors, on the other hand, suffer from the disadvantage that they are easily and undetectably triggered, which creates a considerable nuisance, especially in a prison.

It is an object of the present invention to provide a window grill structure which constitutes an electrical capacitor, whereby an attack upon the structure can readily be detected by means of a capacitance-responsive detector without the disadvantages referred to above.

SUMMARY OF THE INVENTION

According to the invention, a window grill of the kind described comprises an assembly of tubular metallic grill elements, a system of metal rods located within the grill elements, insulating spacers the metal rods, and means for providing electrical connections to the grill elements and the rods, the window grill thus forming an electrical capacitor.

One embodiment of the invention will now be described, by way of example, in the context of a jail security system, including cell windows constructed in accordance with the present invention, alarm sensing means for use therewith, and a central supervisory and indicating system.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings,

FIG. 1 is a schematic block diagram of the complete system;

FIG. 2 is a wiring diagram of an alarm and supervisory unit and audio annunciator;

FIG. 3 is a sectional view of an individual window structure; and

FIG. 4 is a wiring diagram of a sensing circuit for sensing changes of capacitance in the window structure.

It should be noted that the circuits of FIGS. 2 and 4 are electrically interconnected, the common points of the two circuits being denoted by the letters A, C, D, E, F and G, respectively.

Referring to FIG. 1, the security system comprises a plurality of window grills 1, each constructed so as to constitute a sensing capacitor in the manner described below with reference to FIG. 3. The window grills, or sensing capacitors, are connected in pairs to respective capacitance responsive sensing units 2 for sensing changes of capacitance of any sensing capacitors. The construction and operation of the sensing units is described below with reference to FIG. 2. Alarm signals from the sensing units are received by a supervisory unit 3 located at a guard control point, and on receipt of the alarm signal a visual indicator is illuminated and an audio annunciator 4 is operated. A further supervisory unit 6 at a main control point is connected to receive signals from the unit 3 and also from other similar supervisory units associated with other zones of the system. In FIG. 1, only the window grills, sensing units, and supervisory unit of a single zone of the system are shown, the system being similar in the other zones. Associated with the supervisory unit 6 is an audio annunciator 5, and a power supply for the whole system is indicated at 7.

The electrical circuits of the supervisory unit 3 and audio annunciator 4 are illustrated in FIG. 2. The supervisory unit comprises a plurality of visual indicators constituted by electric lamps 8, each of which is connected to and operable by a respective sensing unit when the latter responds to a change of capacitance. The indicators 8 are connected by a common supply circuit 9 to a common direct current source 10, so that when any indicator is energized direct current will flow from the source through the circuit 9. The supervisory unit includes a manually operable resetting switch 11 for resetting any indicator after operation thereof in a manner described hereinafter. The supervisory unit also includes a manually operable switch 12 for testing the operability of the system.

A transformer 13 inductively couples the supply circuit 9 the supervisory unit to an input circuit of the audio annunciator 4. The primary

14 of the transformer is connected in the supply circuit 9 so that a

of current will appear in the secondary winding 15 of the transformer when ever an indicator 8 is operated. The secondary Q1, Q4 15 is connected across the input terminals of a trigger circuit which comprises an amplifier 17 for amplifying electrical input pulse, and a bistable circuit formed by transistors 18 and 19. In the normal condition of the bistable circuit the transistor 18 is conducting and transistor 19 is nonconducting. When a trigger pulse is received, a negative going voltage swing is placed on the base of transistor 19, whereupon the collector current of transistor 19 increases and causes the base of transistor 18 to swing more positive; the accumulative action is to switch transistor 18 OFF and transistor 19 ON. The transistor 19 will remain ON because it derives its base current through resistors 20, 21 until a manually operable reset pushbutton 22 is closed. By this action the base of transistor 19 is connected to a positive terminal 23, thereby switching transistor 19 OFF and transistor 18 ON. During the alarm condition, i.e. after receipt of a trigger pulse, a portion of the collector current of transistor 19 flows through a buzzer or other electrically operated audio alarm, causing it to operate.

The principal advantage of this kind of circuit lies in the fact that the audio alarm will be operated both when an indicator lamp is illuminated and when it is extinguished. If the indicator lamp is illuminated and cannot be reset for any reason, the audio annunciator will remain sensitive to other indicator lamps of the supervisory unit during the time when the one indicator lamp is illuminated. In this way the audio annunciator will be triggered by any change of status of the alarm system whether or not one or more alarms have been received.

Referring now to FIG. 3, each window grill comprises a pair of vertical, tubular, steel side members 25, which are embedded in a concrete wall structure 26, and a plurality of horizontal, tubular steel grill elements 27 connected between the side members. The side members 25 and the top and bottom grill elements 27 constitute a tubular peripheral frame of the window. Each grill element 27, which is welded to the side members at each end, is open ended and projects at each end into the side member through an opening therein. Metal rods

28 are located within the tubular elements 27 and supported in spaced relation thereto by insulating spacers 29. The rods 28 are interconnected at their ends by vertical conductors 30 in the form of metal straps.

It will be observed that the tubular members 25 and 27 constitute one electrode of an electrical capacitor, the other electrode of which is constituted by the rods 28 and straps 30. Electrical connections to the electrodes are made by means of a lead 31 connected to the outer electrode, and a coaxial cable 32 whose center conductor 33 is connected to the inner electrode. The outer conductor of the coaxial cable 32 is not connected to any part of the window structure.

It will be appreciated that the capacitance of the window structure will be changed by any deformation of the grill elements, or by bridging the capacitor electrodes, or by severing the lead 31 or cable 32. Tampering with the window may therefore be detected by a capacitance-sensitive sensing circuit, which circuit will now be described with reference to FIG. 4.

In FIG. 4 the sensing capacitor constituted by the window structure of FIG. 3 is shown diagrammatically as a condenser X connected across terminals B and C.

The inner conductor 33 of the coaxial cable 32 is connected to terminal B and the outer conductor of the coaxial cable is connected with the lead 31 to terminal C. The sensing unit includes a first RC oscillator formed by a transistor Q2, capacitor C1, and resistors R4, R5 and R6, the oscillator having a first frequency-determining circuit formed by resistor R4 and capacitor C1. A second RC oscillator is formed by a transistor Q3 with capacitor X, and resistors R8, R9, R10 and R11, the oscillator having a second frequency-determining circuit formed by resistors R9 and R10 and the capitance X. The resistor R9 is adjustable to permit adjustment of the frequency of the second oscillator within certain limits to compensate for window capacitance variation from unit to unit.

A coupling impedance constituted by resistor R12 is included in the voltage supply to the two oscillators to permit a small amount of mutual coupling between the oscillators in known manner. The purpose of this mutual coupling is to permit electrical locking of the oscillator frequencies. Such electrical locking is required to make the alarm insensitive to changes of the electrical circuit parameters, which may result, for example, from aging of components, variations in the power supply, and changes in environment. The mutual coupling is not sufficient, however, to prevent the frequencies of the oscillators from drifting apart should the window capacitance be changed by more than a small predetermined amount. A detector circuit comprising a transistor Q4 is coupled to the first and second oscillators by means of capacitors C2 and C3 and resistors R7 and R13. If the frequencies of the oscillators should drift apart, representing an alarm condition, the beat frequency which is the difference between the oscillator frequencies is detected and amplified by the circuit of transistor Q4. The amplified beat frequency signal is amplified further by a transistor Q5 and applied to the base of a transistor Q6 which forms an input circuit to an electronic switch constituted by transistors Q7 and Q8 connected in a bistable circuit. The transistor Q7 is normally biased ON by means of current flowing through resistor R24 to the collector of transistor Q8, which is OFF. The base of transistor Q8 is connected by means of resistor R24 to the collector of transistor Q7 which is at low potential when the transistor Q7 is on. When a beat frequency signal corresponding to an alarm condition is received, a direct current signal appears across the rectifying circuit formed by diode D1 and resistor R21 in the base circuit of transistor Q6. This signal drives the transistor Q7 base negative and switches the transistor OFF and transistor Q8 ON. Output current from transistor Q8 is supplied via lead F to a respective indicator 8 of the supervisory unit 3 shown in FIG. 2.

A feature of the circuit shown in FIG. 4 is the provision of a supervisory test facility for testing whether the system circuits are operational. The resistor R4, forming part of the frequency-determining circuit of the first RC oscillator, is in parallel with a transistor Q1 wired in series with a resistor R3. The base of the transistor Q1 is connected to the midpoint of a pair of resistors R1, R2. When point A is connected to earth, by closing the pushbutton switch 12 of FIG. 2, the transistor Q1 is switched on and so the effective resistance of the first frequency-determining circuit is lowered. The oscillator frequencies drift apart, therefore, and an alarm signal is produced.

The general operation of the system will now be described. Referring to FIG. 1, the sensing capacitors 1 are the window structures of individual jail cells, and are connected in pairs to the alarm sensing units 2 located in the jail door housings. The sensing units 2 of each zone are connected to a supervisory unit 3 as previously described. When an attempt is made to deform or sever a jail window, capacitance is changed, thus changing the frequency of the second oscillator Q3 of the sensing unit circuit shown in FIG. 4. The beat frequency signal produced results in the transistor Q8 being switched ON, as previously described, and a respective indicator lamp 8 in the supervisory unit 3 is illuminated. At the same time the audio annuciator 4 is actuated, attracting the attention of a guard at the guard control point, who can see from the indicator which lamp sensing unit has been operated. Simultaneously with the alarm indication at the guard control point an alarm signal is sent from the supervisory unit 3 to the main supervisory unit 6 at the main control point. The audio annunciator 5 is operated to attract the attention of an operator, who can see which of the zone supervisory units has received the alarm signal. The guards at the main and guard control points reset the audio annunciators by depressing pushbuttons 22, and the guard at the guard control point is then advised to reset his alarm by depressing pushbutton switch 11. If the alarm cannot be reset, the cause of the alarm will be investigated in the normal manner, during which time the remainder of the security system remains operational.

The values of the electrical components of the circuits described herein are, in a typical system, as follows:

	In FIG. 2		
R27	6,800 ohms	R33	100 ohms
R28	150 ohms	R34	1,000 ohms
R29	6,800 ohms	R35	15,000 ohms
R30	100 ohms	R36	15,000 ohms
R31	47,000 ohms	R37	1,000 ohms
R32	1,000 ohms		
C1	0.47 mf.		
C2	0.1 mf.		
C3	0.1 mf.		
Q9	Transistor Type 2N1302		
Q10	Transistor Type 2N1302		
Q11	Transistor Type 2N1303		
Q12	Transistor Type 2N1303		
Indicator lamps 8	12 v. 50 ma.		
Transformer 13	Hammond, Type 1635		
	In FIG. 4		
R1	1,000 ohms		
R2, R4	33,000 ohms		
R3	1 megohm		
R5, R10, R26	470 ohms		
R8	27,000 ohms		
R9	10,000 ohms		
R6, R11	22,000 ohms		
R7, R13, R17, R24	10,000 ohms		
R14	100 ohms		
R15	100 ohms		
R16	4,700 ohms		
R18	6,800 ohms		
R19	68 ohms		
R20, R22	15,000 ohms		
R23	1,800 ohms		
R25	2,200 ohms		
C1	0.001 mf.	C5	0.03 mf.
C2, C3	0.02 mf.	C6	0.01 mf.
C4, C7	20 mf.	C7	10 mf.
D1	Type IN34		
Q1, Q4	Transistors Type 2N1303		
Q2, Q3	Transistors Type 2N1671		
Q5	Transistor Type 2N1308		
Q6	Transistor Type 2N1302		
Q7	Transistor Type 2N1302		
Q8	Transistor Type 2N1302		

What we claim as our invention is:

1. In combination with a capacitance-responsive signalling means having input terminals for the connection thereto of a capacitance element,

metallic grill elements, a system of metal rods located within the grill elements, insulating spacers supporting the rods within the grill elements in spaced relation thereto, conductor means interconnecting the metal rods, and conductor means electrically connecting the grill elements and the rods respectively to said input terminals, the window grill thus constituting said capacitive element.

2. The combination claimed in claim 1, the window grill having a tubular peripheral frame wherein the conductor means interconnecting the metal rods are disposed.

3. In combination with a capacitance-responsive signalling system having input terminals for the connection thereto of a capacitive element,

a window grill comprising a peripheral frame having a pair of tubular metallic side members, and a plurality of open ended tubular metallic grill elements extending between,

and connected to, the side members, the open ends of the grill elements cooperating with respective openings in the side members, a plurality of metal rods located within the grill elements and extending therealong, insulating spacers located within the grill elements and supporting the rods in spaced relation thereto, conductor means located within the side members and electrically interconnecting the metal rods, the peripheral frame and the rods being electrically connected to the input terminals of the signalling means respectively, the window grill constituting said capacitive element.

4. The combination claimed in claim 3, wherein the peripheral frame is rectangular and comprises said side members and top and bottom tubular members extending between the ends of the side members, the peripheral frame and grill elements providing a totally enclosed space wherein the metal rod and conductor means are located.

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