United States Patent

Lemelson

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[54] BUILDING MAINTENANCE APPARATUS

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[51] **Int. Cl.**.....**A47l 1/02, A47l 11/00**

[58] **Field of Search**.....15/21, 103, 302, 312, 319, 15/50 C, 98; 114/222; 52/749; 118/207, 305

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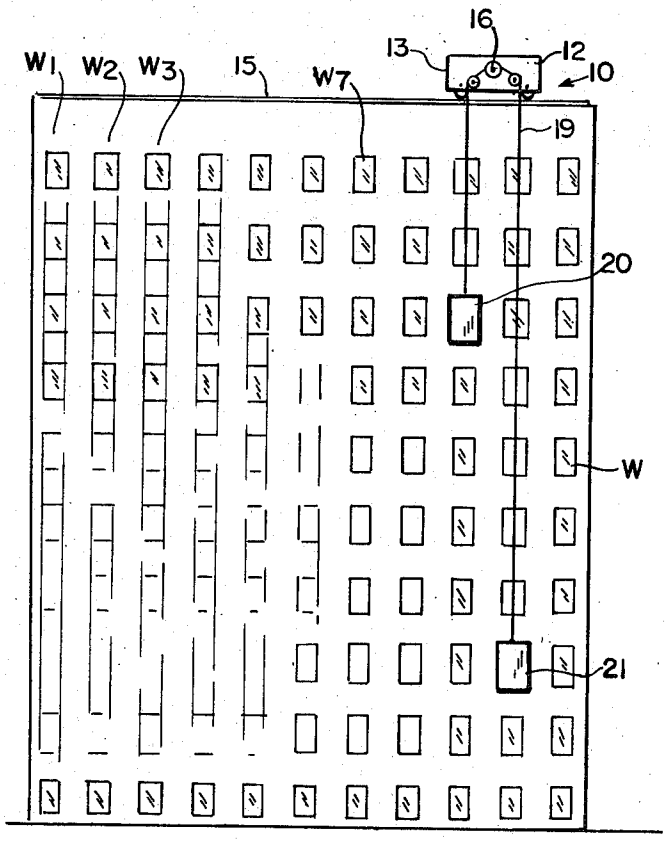
[57] **ABSTRACT**

A building maintenance apparatus is provided for performing automatic operations on the facing of tall buildings such as the operation of automatically cleaning the windows or side panels thereof. Automatic cleaning machinery is suspended from a cable which is supported from above on a fixture which is movable laterally across the sidewall of the building to position the suspended cable and cleaning machinery with respect to particular locations such as vertical rows of windows or side panels. The cable is raised and lowered either automatically or intermittently to position window- or panel-cleaning machinery with respect to individual windows or panel sections which machinery automatically operates either continuously or intermittently to clean said windows or panels.

In one form of the invention, two cleaning machines or fixtures are provided, one at each end of a cable having a length approximately equal to the height of the building or portion thereof to be cleaned and these machines serve to counterbalance each other with respect to a winch which is supported from above and selectively positionable with respect to different rows of windows. Automatic means are provided for not only moving the cable-supported cleaning machines vertically first in one direction and then in the other in the act of cleaning windows or building panels but also for shiftably locating the cable support to bring the machines into alignment with new portions of the building to be cleaned.

10 Claims, 6 Drawing Figures



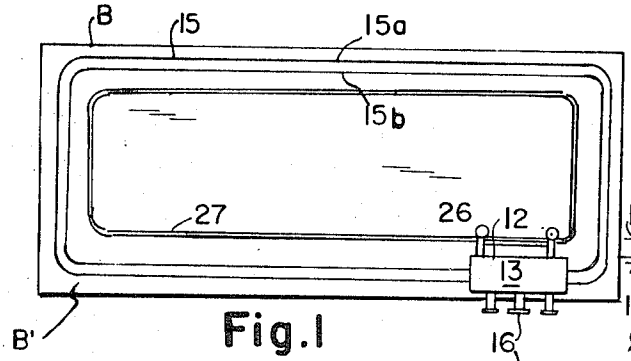


Fig.1

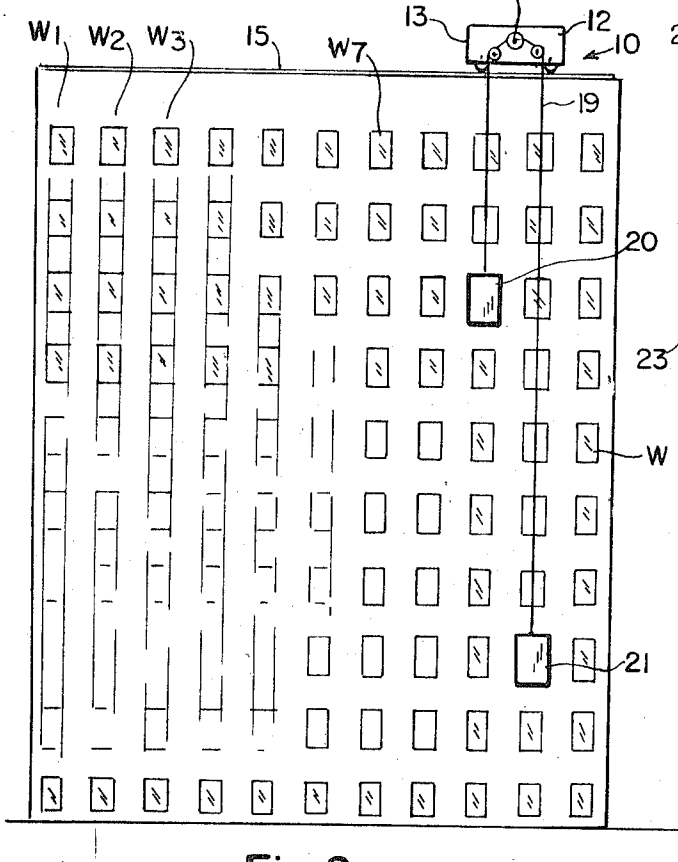


Fig.2

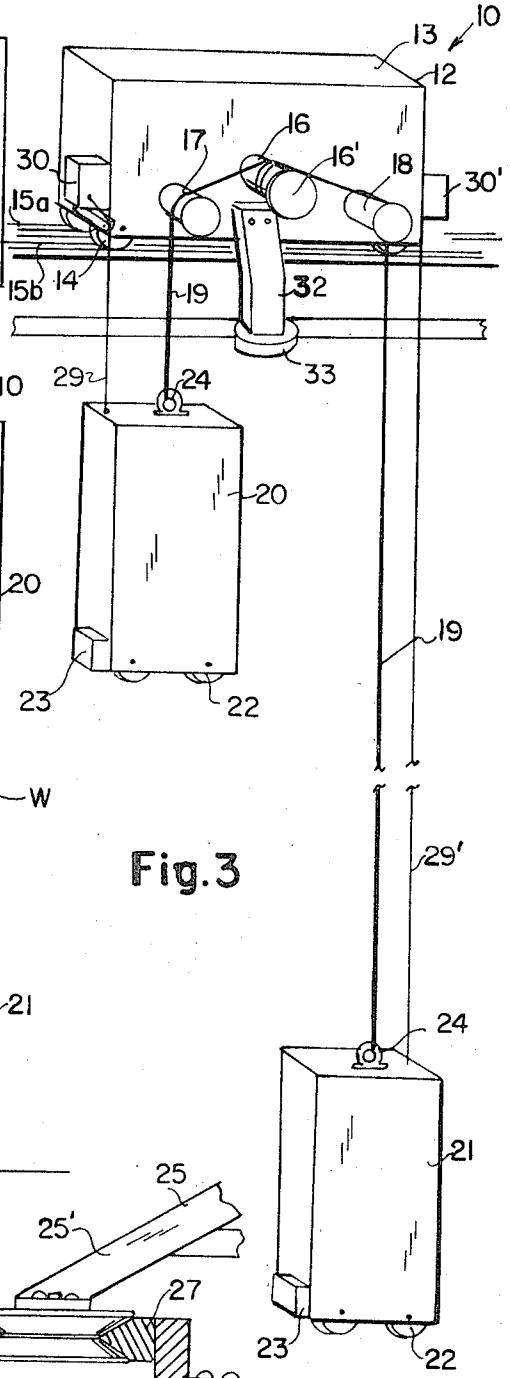


Fig.3

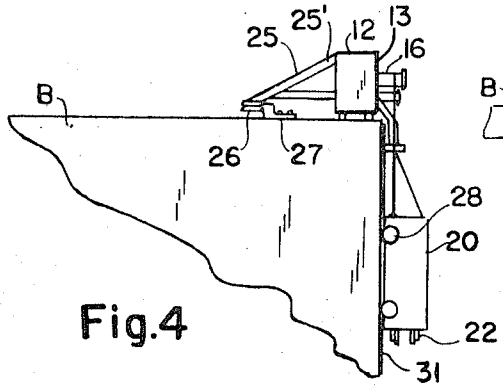


Fig.4

Fig.5

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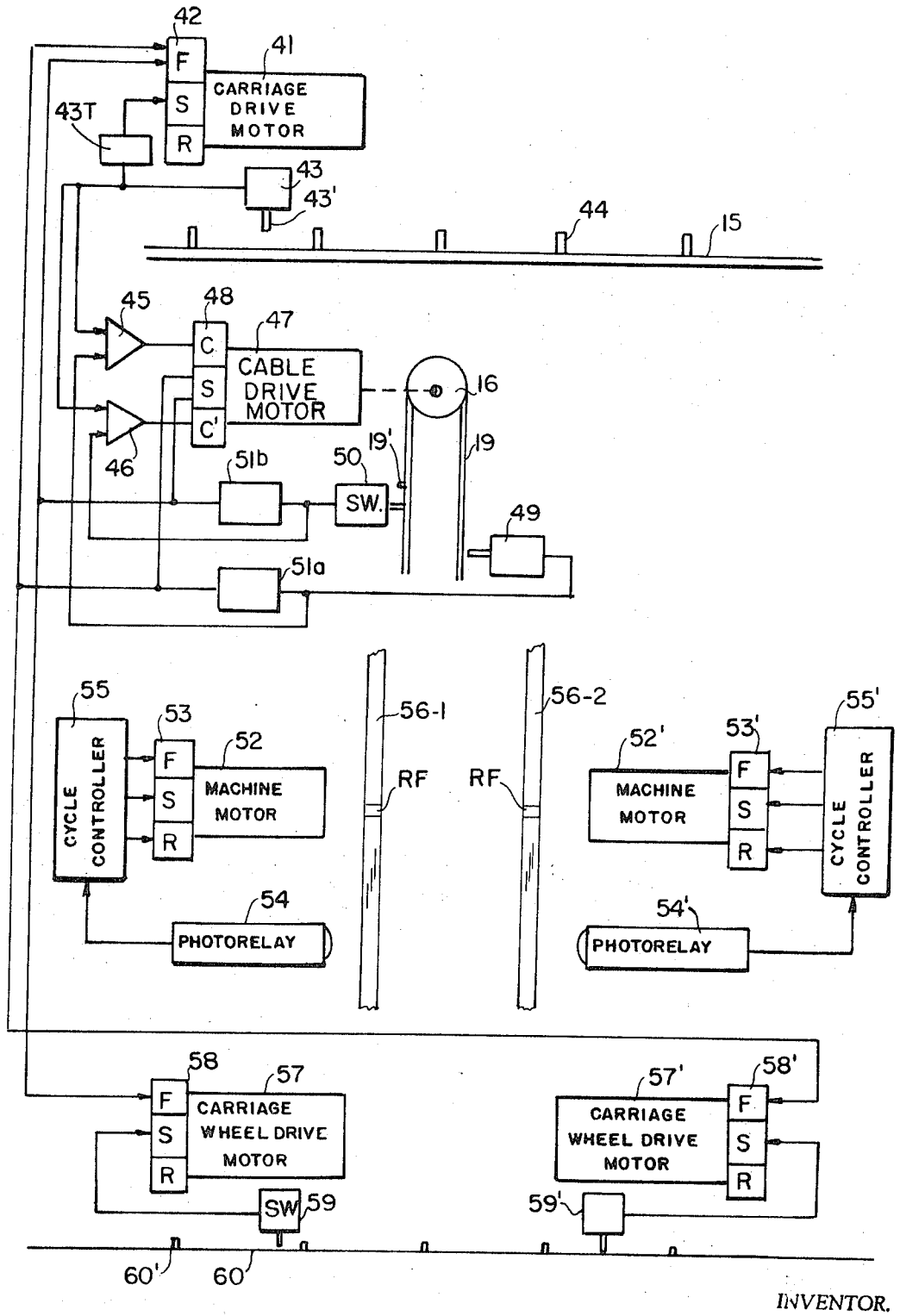

Fig.6

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BUILDING MAINTENANCE APPARATUS

SUMMARY OF THE INVENTION

This invention relates to an apparatus for automatically cleaning the side wall of a building, panels thereof or windows which are predeterminately aligned in parallel vertical rows. The apparatus is particularly applicable for the cleaning of windows of tall buildings such as skyscrapers which have heretofore been cleaned by hand usually at great risk to a person who must hang outside of each window in order to clean same.

The apparatus comprises a carrier which is supported on a trackway located either on the roof of the building or or a subroof section terminating at one portion of a skyscraper.

It is a primary object of this invention to provide a new and improved apparatus for cleaning the side wall or windows of multistory buildings without the need for human attendance.

Another object is to provide an automatic window-cleaning apparatus and a building constructed especially not only to receive and utilize said apparatus but to simplify the operation of cleaning the windows thereof by means of said apparatus as the result of specifically designing the building, its side wall and windows.

Another object is to provide an automatic window-cleaning apparatus which is substantially totally supported by the building itself from above.

Another object is to provide an automatic window-cleaning apparatus including a window-washing machine which is movable around the building and capable of cleaning windows located along a plurality of walls of said building.

Another object is to provide an automatic cleaning apparatus for cleaning the windows or walls of tall buildings which comprises two cleaning machines supported at opposite ends of a cable having a length substantially equal to the height of a building, the assembly being supported from above on a power rotated winch in a manner to provide the two machines counterbalancing each other so as to substantially simplify the mechanism used to drive the machine up and down with respect to the building side wall while each cleans a different row of windows.

With the above and such other objects in view as may hereafter more fully appear, the invention consists of the novel constructions, combinations and arrangements of parts as will be more fully described and illustrated in the accompanying drawings, but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of the invention as claimed.

In the drawings:

FIG. 1 is a top view of a multistory building showing automatic window-washing machinery supported on the roof thereof and movable along a trackway extending around said roof;

FIG. 2 is a side view of a building of FIG. 1 showing a complete side wall thereof and further details of the window-washing machinery,

FIG. 3 is an isometric view in greater detail of the window-washing machinery shown in FIG. 2;

FIG. 4 is a side view in greater detail of the window-washing machinery of FIGS. 2 and 3;

FIG. 5 is an end view of part of the mechanism shown in FIG. 4; and

FIG. 6 is a schematic control diagram for the major operative components of the window-washing apparatus shown in FIGS. 2—4.

There is shown in FIG. 1 to 5 an apparatus 10 operable for performing automatic operations on the side wall and/or windows of a tall building B such as a multistory office or apartment building, a skyscraper or the like.

The building B illustrated in FIG. 1 contains a plurality of vertically extending rows W1, W2, W3, etc., of windows W to be periodically washed by means of the automatically operating apparatus 10. The apparatus 10, upon modification of a portion thereof, may also be utilized to paint or wash the side walls of the building B.

The apparatus 10 comprises a transport assembly 12 having a carriage 13 rotationally supporting two or more pairs of wheels 14 which are power operative to drive the carriage along a trackway 15 which is disposed parallel to the side wall B-1 of the building shown in FIG. 1. The track 15 comprises a plurality of rails 15*a* and 15*a* illustrated in FIGS. 2 and 3, which rails may extend either parallel to one face of the building for servicing said face or side wall or completely around the roof B' as shown in FIG. 1, thereby permitting the carriage to travel parallel and adjacent to each of the side walls of the building to effect servicing or cleaning of windows disposed each sidewall as the carriage moves from one section thereof to another.

Depending downwardly from the carriage 13 is a cable 19 having a length equal to about the height of the building and having secured to each end thereof a different platform assembly denoted by notations 20 and 21. The platforms or window-washing machine assemblies 20 and 21 are separated from each other a distance equivalent to the distance between two vertical rows of windows as illustrated in FIG. 2 by means of a pair of separator or guide drums 17 and 18 which are supported by the wall or frame of the carriage 13 and protrude a sufficient distance beyond and outwardly from the sidewall of the building to suspend the two platforms 20 and 21 at the ends of the cable 19 a predetermined distance from the building side wall to permit the platforms or machines 20 and 21 to travel vertically upwardly and downwardly on the ends of said cable so as to preposition same with respect to respective windows of the vertical rows they are respectively aligned with. The cable 19 winds around each drum 17 and 18 and then extends over and around a drive drum 16 which is also rotationally supported by carriage 13 and the cable 19 which is preferably a multistrand steel cable of the type illustrated in FIG. 6, is wound a number of times around the drum 16 so that when said drum is power rotated in either direction, said cable will be driven in each direction to raise and lower the two platforms or machine assemblies 20 and 21 connected to the ends of said cable.

It is noted that the platform or machine assemblies 20 and 21 are preferably of equal weight so that, with the exception of the different weights defined by different lengths of the cable 19 extending between the carriage and the respective platforms, said platforms or machine assemblies will have a tendency to substantially counterbalance each other thereby substantially reducing the amount of power required to raise and lower said platforms. The drum 16, like drums 17 and 18, contains a head6' of greater diameter than the main portion of the drum to prevent the cable from slipping off the end thereof. Said drum 16 is preferably power rotated by a reversible electric motor located within the housing of carriage 13 and coupled to said drum by means of suitable gears. Thus when the drum 16 rotates in one direction such as clockwise, machine assembly 20 will be lifted while machine assembly 21 will be lowered. Notation 32 refers to an arm of structural member secured to the body or frame of the carriage 12 and mounting a wheel 33 at its end which engages a rail 34 secured to the building wall for support of said carriage. Reversal of direction of rotation of drum 16 (counterclockwise) will cause machine assembly 20 to be lowered and machine assembly 21 to be raised.

When one of the machine assemblies 20 or 21 is at its highest or uppermost point of travel, preferably in alignment with the top of the building or the topmost row of windows W, the other machine assembly or platform is at its lowermost point of travel whereby wheels 22 which are rotationally supported at the bottom of said assembly ride either on the ground or the roof of the next level of the building or on tracks disposed thereon. Each of the carriages or machine assemblies 20 and 21 is provided with a plurality of wheels 22 and a motor 23 for power rotating said wheels to drive the machine assembly in a desired direction so as to preposition it in alignment with the next portion of the building or vertical row of windows which it is to clean. The machine assembly or platform situated at the highest location is shifted to its next

horizontal position or row of windows which it is to clean by power driving the carriage **13** along its trackway **15** until said location is derived therefore. The operations of the drive means for the carriage **13** and the motor **23** of that platform or machine assembly which is located at ground level and resting on its own wheels, are preferably synchronized so that both machine assemblies will travel simultaneously across the face of the building with the portions of the cable **19** extending to each platform being disposed substantially vertically during said movement.

The operation of the motor driving the cable **19** for lifting and lowering the platforms **20** and **21**, the motors operating the carriage **13** and the lowermost platform to drive same in the horizontal direction for prepositioning the two platforms, and the one or more motors located on each of the platforms for performing one or more cleaning operations with respect to the windows or side wall of the building, are all preferably controlled by limit switches or by a single master controller such as a multicircuit timer or other form of preprogrammed controller or computer which is operative to effect the desired mode of operation of the apparatus **10** such as the cleaning of all windows located on one or more walls of the building B, the cleaning, painting or otherwise processing of the entire side wall of the building or other operation with respect to the building such as one or more operations associated with the construction of the building. Such control apparatus will be defined after descriptions of mechanical aspects of the instant invention.

In FIG. **4** is shown a side view of an upper portion of a building B, the carriage **13** and means for further stabilizing or supporting the carriage to prevent it from tiltably moving off its rails **15***a* and **15***b*. While means may be provided in the form of specially shaped wheels and rails to securely retain the carriage **13** thereon during the operation and preventing it from tipping off the the side of the building, in FIG. **4** is shown a frame **25** of a plurality of structural beam **25'** which are secured to the carriage **13** and extend inwardly of the edge of the building. Wheels **26** are rotationally mounted near the end of the frame **25** and extend substantially horizontally to rotate about a vertical axis against a rail **27** securely held against the roof of the building as shown, thereby preventing movement of the carriage **13** beyond the rails **15** such as in tipping off the building.

The building B may be specially constructed so as to properly space all windows W an equal horizontal distance apart and vertical distance one above the other in rows as illustrated. The machine assemblies **20** and **21** or platforms may move freely up and down on the ends of the cable **19** without further support or guidance, or may each operate in its own vertical shaft or track of a horizontally movable frame or may each be movable up and down on one or more rails secured to the sidewall of the building. If a single frame is provided it may be horizontally movable to carry the platforms or machine assemblies **20** and **21** horizontally therewith and may be attached to or contain the carriage **13** at the upper end thereof. Such a frame (not shown) may contain wheels or other guide means drivable along respective horizontally extending rails secured to the building side wall at a plurality of height locations thereof. Certain of the machine arrangements or portions thereof which will be described hereafter and are illustrated in the other drawings, may also be incorporated in the system illustrated in FIGS. **1–5** without departing from the spirit of the instant invention.

In FIG. **3**, notation **29** refers to a flexible cable containing a plurality of electrically conducting wires extending from a housing **30** containing a self-reeling mechanism to the electrically operated machinery of the platform **20**. A similar cable **29'** extends from platform **21** to a self-winding mechanism located in the housing **30'** secured to the other end of the carriage **13**. Each of the housings **30** and **30'** at opposite ends of the carriage **13** contain means for connecting the individual wires of the cables **29** and **29'** to suitable controls and sources of electrical energy connected through said controls to one or more motors, solenoids and other electrically operated devices located on the platforms **20** and **21**. Control of the operation of the apparatus described may be effected by limit switches and/or transducers operative to sense markers, dogs or other means located along the path of travel of the platforms and the carriage **13**. Also shown in FIG. **4** are wheels **28** rotationally supported on the sidewall of carriage **20** which engage either the sidewall of the building or respective rails **31** extending parallel to each row of windows. Four free wheeling wheels **28** may thus support each carriage- or window-cleaning machine during its vertical travel upwardly and downwardly past each row of windows.

FIG. **6** illustrates a control system for the apparatus **10** shown in FIGS. **1–5**. A reversible gear motor **41** power drives the carriage **13** along the described roof located track **15** and has controls **42** including forward, stop and reverse controls designated F, S, and R which, when energized by signals generated on inputs thereto, effect the forward and reverse drive and stoppage of said carriage **13** to bring the apparatus supported thereby into alignment with the selected vertical row of windows as described. The control diagram of FIG. **6** has been simplified by omitting the electrical power supply means and it is assumed that the proper power supplies are provided on the correct sides of all switches, motors, transformers, photoelectric detectors, logical switching circuits and other components to permit them to function as described.

A limit switch **43** depends from the carriage **13** and has a deflectable actuator arm **43'** operative to effect closure of the switch whenever it comes into alignment with a pin or dog **44** situated on or adjacent the track **15**, there being at least one such dog positioned to locate each row or pair of rows of windows and to properly effect stoppage of the carriage **13** with the subtending, cable supported machines **20** and **21** each aligned with a respective row of windows.

When the actuator arm **43'** of switch **43** is deflected by a dog or pin **44** protruding from track **15** as the carriage moves, it generates a control signal which is passed to the stop control S of carriage drive motor **41** to properly stop said carriage whereby the window-washing machines **20** and **21** which are supported by a cable suspended from the carriage are each located in alignment with a different vertical row of windows. As it is desired to reverse drive the cable **19** for proper realignment of the carriage **13** after the previous cleaning operations since the cable has been completely paid out in one direction, the motor **47** is operated to drive the cable **19** in reverse only after the carriage **13** is predeterminately positioned to so properly align the machines connected to the cable. Therefore, the output of switch **43** is also passed to the first switching inputs of two logical AND-circuits **45** and **46**, the outputs of which circuits extend respectively to the forward and reverse control inputs C and C' of the motor controls **48** for reversible gear motor **47** which is used to rotate the cable drum **16** for raising and lowering the machines **20** and **21** located at the ends of the cable driven around drum **16**.

To control the operation of cable drive motor **47** to be stopped when the platforms **20** and **21** have reached the endmost locations of their travel and to further effect reverse driving of the platform supporting cable, limit switches **49** and **50** are supported by the carriage **13** adjacent portions of the cable on respective sides of the drum **16** and are located such that at least one of said switches becomes actuated when a respective dog or pin, one of which **19'** is shown in the drawing, attached to said cable near the ends thereof, depresses or deflects the respective switch actuator to effect automatic control. The output of limit switch **49** is connected to the other switching input of AND-circuit **45** so that after said switch is actuated and when the switch **43** is actuated, AND-switching device **45** will generate an output which is used to energize the control C for motor **47** which starts the motor in operation to drive the cable **19** in the reverse direction to that in which it was driven during the previous cleaning cycle. The output of switch **49** is also passed to a pulse transformer **51***a* which generates a pulse on its output which is transmitted to

the start control F of the carriage drive motor **41** startingsaid carriage to move towards its next operating location as soon as the pin or dog secured to cable **19** actuates switch **49**. The activation of AND-switch **45** occurs some time thereafter as described when the limit switch **43** becomes actuated as it scans or is deflected by the next dog or pin **44**.

The limit switch **50** senses a dog **19'** located at the other extreme of the cable on which the dog operating switch **49** is located. Upon activation of switch **50**, a pulse is transmitted to a pulse transformer **51***b* the output pulse of which is transmitted to the start control F of the carriage drive motor **41** driving carriage **13** to its next location whereupon switch **43** becomes actuated by a dog **44** located on the track **15** and transmits an output signal to a pulse transformer **43T**, the pulsed output of which is transmitted to pulse the stop control S of carriage drive motor **41** thereby stopping the carriage in alignment with the next cleaning location. The output of **43**, as described, is also passed directly to a switching input of a second AND-switching circuit **46** which remains energized thereby as long as the actuator **43'** of the switch **43** remains depressed while the carriage **13** is in its stopped condition. Since the other input to AND-circuit **46** was previously energized when switch **50** closed, said AND-circuit **46** generates an output signal upon receipt of a signal from the switch **43** and is utilized to pulse the reverse drive control C' of motor **47** for reversing the direction of driven movement of the cable **19**.

While certain cleaning operations may be effected by the continuous operation of the machines **20** and **21** each time the cable drive motor **47** has been energized, in FIG. **6**, photoelectric scanning means are provided on each of the machines to sense markers or other means located adjacent the windows so as to initiate operation of each machine when it comes into alignment with a window and stop its operation after cleaning said window. Notation **52** refers to a motor which is operative to drive the window-cleaning machine on carriage **20** and having controls **53** including forward, stop and reverse controls denoted F, S and R which are activated by respective signals generated on the outputs of a multicircuit controller **55**. The multicircuit controller or timer **55** is activated or initiated in its operation each time a limit switch or sensor **54** such as a photoelectric cell, power supply control means therefore is activated. The photoelectric detector unit **54** may include a light source and photoelectric cell adjacent therefore and so located as to scan a strip or band area denoted **56-1** extending vertically and parallel to a particular vertical row of windows. If the scanning area **56-1** includes reflective markers RF located so as to initiate the operation of the cleaning machine, a light cell located within the photoelectric detector **54** may project a beam of light against said band area which, upon alignment of a photoelectric cell existing therein, may reflect light back to the photoelectric detector **54** which generates an output signal which is passed to the multicircuit controller **55** to automatically and sequentially operate the particular washing machine. Similar controls having the same notations primed are provided for the other machine subtending from the other end of the cable supporting the machine controlled by motor **52**. A photoelectric scanner and detector **54'** preferably includes a light source and photoelectric cell as well as controls therefore adapted to become energized upon scanning respective reflecting markers located on a strip or band area **56-2** extending parallel to another row of windows.

Also shown in FIG. **6** are motors **57** and **57'** which respectively drive the described wheels **22** of the carriages **20** and **21** to cause the lowermost carriage to travel horizontally when located at the ground or lower roof level. Pins or dogs **60'** located on the track **60** or the ground along which the lowered carriage travels, are predeterminately spaced and used to deflect the actuator arms of switches **59** and **59'** when the carriages of the washing machines are respectively located in proper alignment with the respective rows of windows to be cleaned thereby. The switches **59** and **59'** of the override actuator type so that as they pass a dog, a pulse is generated on the output of that switch which is so actuated and is passed to stop control S of the respective motor for stopping the lowermost working machine substantially in alignment with the next row of windows to be cleaned thereby. Each of the forward drive controls F of the control means **58** and **58'** of the motors **57** and **57'** are connected by wire or short wave to the outputs of pulse transformers **51***a* and **51***b* so that said motors will start to drive their respective carriage when a respective of the limit switches **49** and **50** becomes activated (i.e.,—when the carriage containing the motor is located at ground level as indicated by that dog mounted on cable **19** which deflects its limit switch **49** or **50**). The forward control F of motor **57'** is connected to the output of pulse transformer **51***a* extending from limit switch **49** and the forward control E of motor **57** is connected to the output of pulse transformer **51***b* of limit switch **50** so that either of the two motors becomes activated when its carriage is at its lower most position with the wheels thereof on the ground or lower trackway **60**.

As stated, it is noted that the photoelectric detection means **54** and **54** of FIG. **6** for detecting the vertical locations of windows may be replaced by respective electromechanical limit switches actuated by pins or dogs disposed along the building side wall or track **31** at each window location and in the paths of the actuator arms of said switches. Details of the building maintenance or washing machines supported by the platforms **20** and **21** are not shown in the drawings in detail. If the apparatus is to be utilized to clean vertical rows of windows which are mounted substantially flush with the sidewall of the building and said sidewall is substantially flat and free of obstructions, the window-washing machines supported by platforms **20** and **21** may support one or more power rotated cylindrical or circular cleaning brushes of the type shown in my U.S. Pat. No. 3,327,339 which brushes may extend the width of the windows or building area to be cleaned and rotate continuously as they are raised or lowered on their respective platforms so as to clean both the windows and building wall panelling therebetween during their vertical travel. Suitable cleaning liquid may be dispensed from respective tanks supported by the platforms **20** and **21** or supplied through sections of flexible hose extending to said platforms from carriage **12** in a manner similar to the power lines **29**. Such hose may also extend from another carriage (not shown) which is movable along a track at ground level or the next roof level below and is automatically controlled and powered to move with the movement of the overhead moving carriage **12**. The cleaning liquid may be dispensed as a spray from one or more nozzles supported by the platforms **20** and **21** to provide sufficient liquid to clean said windows and/or building wall or panelling.

The brushes and spray means may also be intermittently operated to effect a cleaning operation when properly aligned with each window. The described automatic sensing and control means may be utilized to initiate said intermittent cleaning operations each time a window locating mark or device is sensed.

I claim:

1. An apparatus for maintaining portions of the siding of buildings and the like comprising:

a. a first carriage,

b. guide means for said first carriage extending substantially horizontal and supported by said building,

c. means for power driving said first carriage along said guide means,

d. winching means for supporting and driving a cable supported by said first carriage,

e. a cable having both ends extending downwardly from said first carriage substantially parallel to the side wall of said building,

f. reversible drive means for said winching means and operative to effect the raising of a first end of said cable and the lowering of the other end thereof when operating in a first mode and the lowering of said first end and raising of the other end thereof when operating in a second mode,

g. control means for said winching means drive means,

h. power operated building maintenance means supported at one end of said cable and counter balancing means at the other end of said cable,

sequential control means for controlling operation of said means driving said carriage and said power means for said winching means to predeterminately alternately move and stop said carriage whereby said building maintenance means is first located with respect to a first pathway extending vertically of the sidewall of the building and is driven by said winching means in a first vertical direction along said pathway and upon reaching the end of its travel is stopped while said carriage moves to position said maintenance means in alignment with a second vertically extending pathway adjacent the side of the building.

i. sequential control means for controlling operation of said means driving said carriage and said power means for said winching means to predeterminately move and stop said carriage whereby said building maintenance means is first located with respect to a first pathway extending vertically of the sidewall of the building and is driven by said winching means in a first vertical direction along said pathway and upon reaching the end of its travel is stopped while said carriage moves to position said maintenance means in alignment with a second vertically extending pathway adjacent the side of the building.

j. said sequential control means including means for operating said winching means to reverse the direction of travel of said cable to cause said building maintenance means to travel in the opposite direction to that travelled in its movement along said first vertical pathway.

2. An apparatus in accordance with claim 1, whereby said building maintenance means comprises a window-cleaning machine, said control means being operative to predeterminately locate said carriage whereby said machine is aligned on the cable supported by said carriage with different rows of windows extending vertically of the sidewall of the building, and means for operating said machine when aligned with a vertical row of windows and vertically moved on said cable, to wash the windows of said row.

3. An apparatus in accordance with claim 1, said counterbalancing means comprising a second building maintenance machine, and means for simultaneously operating both said machines to respectively operate on different vertical pathways as one machine is conveyed upwardly and the other is conveyed downwardly on the ends of said cable.

4. An apparatus in accordance with claim 1, said building maintenance means including carriage means having wheels disposed thereon and protruding downwardly therefrom so as to support said carriage means on a surface, there being a supporting surface adjacent the sidewall of said building for receiving said carriage means wheels when said carriage means is fully lowered by said winching means, motor means for driving said wheels to drive said carriage means parallel to the sidewall of said building in the direction of and at substantially the same rate of travel as said first carriage when said wheels are on said supporting surface, means for initiating the operation of said motor means to drive said carriage means substantially upon initiation of the power means driving said first carriage and control means for terminating the driving of said carriage means by said motor means when said maintenance means is in alignment with a second pathway vertical of the side wall of said building.

5. Apparatus in accordance with claim 4, said latter control means including marker means for indicating the locations of various vertical pathways parallel to the side wall of the building, means on said carriage for scanning said marker means, and control means responsive to the activation of said scanning means for stopping the means driving the wheels of said carriage means when the latter is aligned with a selected pathway.

6. An apparatus in accordance with claim 3, including auxiliary means for power driving each of said maintenance machines in a horizontal direction when each is at the lowermost position in its travel whereby said first carriage operates only to carry the machine located at the other end of said cable.

7. An apparatus in accordance with claim 6, said machines comprising window cleaning machines, said building having parallel rows of windows which are substantially equispaced one above the other, and means for intermittently operating each machine simultaneously when they become aligned with respective windows of different window rows of said building.

8. An apparatus in accordance with claim 6, said machines comprising respective window-washing machines, said building having parallel rows of windows disposed to define respective pathways for said machines and means for continuously operating each machine as it travels vertically to wash each window of a row as it passes the window.

9. Apparatus in accordance with claim 6, including guide means comprising rails supported said building parallel to each pathway and serving to guide each machine in its travel upwardly and downwardly along said vertical pathways.

10. Building maintenance apparatus for cleaning the windows of a multistory building having a substantially vertical side wall and a plurality of parallel vertical rows of windows, guide means comprising a plurality of parallel tracks extending vertically along said side wall of said building and parallel to said rows of windows, there being at least one track associated with each row of windows, and a window-cleaning machine including a carriage adapted to travel vertically along and be guided by said tracks past respective rows of said windows first vertically upward while cleaning one row of windows and after reaching the upper end of its travel, to be reversed in its direction of travel and move downwardly while cleaning another row of windows on the way down, the improvement comprising: means operative when said window-cleaning machine is at both ends of its travel past respective rows of windows for automatically controlling movement of said machine to shift horizontally to bring it into alignment with the next track associated with the next row of windows to be cleaned and further control means operative when said carriage has been shifted into alignment with said next track for reversing the travel of said machine so that it will move along said next track in the opposite direction to clean the windows associated therewith.

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