To all whom it may concern:

Be it known that I, WILLIAM S. KINSLEY, of Reading, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Driers for Sheet Material, of which the following is a specification.

This invention relates to drying apparatus and has particular reference to machines for suspending and carrying for a considerable length of time a large number of sections of sheet material. The apparatus is designed particularly to carry sheets of quite heavy material of a character known as paper-board, although I do not limit myself to the use of the machine or apparatus with material of specially heavy character.

The object of the invention is to provide an apparatus of the character described which will automatically take hold of sheets of material by their upper edges and carry them in suspended or pendent position for a considerable length of time, either in the open air or through a drying box or room.

In the accompanying drawings I do not illustrate any inclosure for the drying apparatus, it being understood that the entire apparatus may be either contained within a drying room, or the portions of the apparatus which hold and carry the sheets in pendent position may be inclosed by suitable walls, the supply or feeding being effected at one end outside of such an inclosure, and the delivery of the sheets being effected at the other end outside of such an inclosure.

My invention consists in the improvements which I shall now proceed to describe and claim.

Of the accompanying drawings: Figures 1, 2 and 3, taken together, constitute a side elevation of so much of the machine as is necessary to an understanding of my invention. These three figures are drawn on separate sheets as the machine, in its present embodiment, is of such size that a single figure on one sheet would be on a very small scale. Figs. 4 and 5, taken together, represent an end elevation from the right of Fig. 1. Fig. 6 is a side elevation, with the shafts in section, on a larger scale than Fig. 1, illustrating the carrier and its clips which grasp the sheet material and carry the sheets through the apparatus. Fig. 7 is a detail side elevation, with the shafts in section, of the connections between the chains which support the lower edges of the sheets as they are fed into the machine and the chains which are employed to guard or prevent the sheets from dropping. Figs. 6 and 7 taken together illustrate the point where the sheets are supplied to the apparatus. Fig. 8 is a detail view partly in section of one embodiment of the clips for gripping the upper edges of the sheets of material. Fig. 9 is a detail side elevation of a preferred form of clip. Fig. 10 represents a section on line 10—10 of Fig. 6. Fig. 11 is a detail plan view of the left hand portion of the parts of the apparatus shown in Fig. 3. Figs. 12 and 13 are respectively detail side elevation and section of parts shown at the right of Fig. 1.

Similar reference characters indicate similar parts in all of the views.

The fixed members of the frame of the machine include a series of fixed uprights 20 which may be supported either by the floor of the factory or upon base strips 21. As the machine, in its present embodiment, is substantially 100 feet long, there are many of said uprights. The fixed uprights are connected by top bars 22, and at their lower portions are provided with braces 23. These parts so far described apply to the left hand side of the frame considering that the operator stands at the right of Fig. 1. Said parts are also illustrated in Fig. 4. The other side of the machine includes adjustable uprights 24 most clearly illustrated in Fig. 5. As has been mentioned, Figs. 4 and 5 are to be taken together when considering the machine as being viewed from the supply end which is the right hand end of the view represented by Figs. 1, 2 and 3.

It is to be understood that there is an adjustable upright 24 at the right hand side of the machine as a companion for each fixed upright 20 at the left hand side of the machine. Each upright 24 (Fig. 5) has a foot 25 and braces 26, the foot having wheels 27 to run on a track 28. A long top bar 29, or a series of sections connected end to end, to constitute such a long bar, connects the tops of all of the adjustable uprights 24. This provision for adjustment of the uprights 24 and top bar 29 and other parts...
hereinafter described carried by the uprights 24 is to enable the machine to be readily adjusted for sheets of greater or lesser width, which are to be run through the machine for drying purposes.

An endless chain 30 is represented conventionally in Figs. 1 and 2 and more in detail in Figs. 6 and 8. Preferably this chain is of the type commonly known as "roller type". The links 31, however, are specially formed as presently described while the alternating or intermediate links 32 may be standard. This chain constitutes the carrier from which the sheets of material are suspended by the clips presently described. There are two of these chains 30 of course, one along the left hand side of the top of the machine and the other along the right hand side. A description of one will suffice for both. Each chain is mounted upon sprockets 33, 34 carried respectively by shafts 35, 36, the former at the front of the machine and the other near the rear or delivery end as shown in Fig. 2. The shaft 35 is provided with a worm gear 37 (Figs. 1 and 4) which is driven by a worm 38 on a long shaft 39 extending from the front near the rear of the machine, said shaft being mounted in bearings carried by suitable brackets 40 connected to the uprights of the machine. Said shaft is driven by any suitable means such as by a belt run on a pulley 41 secured to the shaft.

Each special link 31 is formed with an ear 42 (Figs. 6 and 8) carrying a fixed jaw 43. It is to be understood, of course, that each chain 30 really comprises two parallel sets of connected links as shown in Fig. 10, the links 31, 32 overlapping each other at their ends. Mounted in the ears of each adjacent pair of links 31 is a pin 44, said pin projecting beyond one ear 42 as shown in Fig. 10 and having a lug 45 connected to it. The other end of the pin 44 projects slightly through the ear of the other or companion link 31 and has secured to it an arm 46 having lugs 47, 48 at its ends. It is by means of this arm 46 that the clip is opened as hereinafter described. Rigidly connected to the pin 44 between the companion ears 42 is a jaw 49 adapted to cooperate with the stationary jaw 43 in gripping the upper edge portion of a sheet of material a. One of the ears 42 is provided with a pin 50 to which is connected one end of a spring 51, the other end of the spring bearing against the lug 45 so as to have a tendency to keep the movable jaw closed against the stationary jaw in the position shown in Fig. 8 and in one of the positions of Fig. 6. The clip structure as so far described relates to that which is illustrated in Figs. 6, 8 and 10. A similarly operating but preferred structure is illustrated in Fig. 9 in which the movable jaw 49 is provided with a lug 52 which passes through an aperture in an arm 53 of the rocking pin 44, a cotter pin 54 retaining the connection. This structure permits the movable jaw 49 to rock relatively to its actuating or carrying arm 53 so as to press the flat jaw 49 squarely against any material between it and the jaw 43.

While the pins 55 (Figs. 6 and 8) of carrier chain 30 are only of sufficient length to connect the links of the companion sets the alternating pins 56 are longer as shown in Fig. 10, to extend onto and ride along a fixed track 57 (Figs. 4, 5 and 10). These tracks are carried by brackets 58 supported by the uprights 20, 24. As shown by comparing Figs. 6 and 10, a track 59 is provided for the pins 48.

After the clips have been closed upon sheets of material supplied thereto as hereinafter described, the sheets are carried 85 along slowly but continuously to the delivery end of the machine at which point it is necessary that the clips shall automatically open to release the sheets. To effect this a contact lug 60 projects from one of the uprights 20 as indicated in Figs. 2 and 6, said contact being in the path of movement of the lower pins 47 of the arms 46 of the clips. As each clip reaches the discharge position, its pin 47 is arrested by the stop 60 so as to swing the movable jaw relatively to the fixed jaw to release the sheet. As each clip passes the lug 60 its spring 51 closes it again. It then becomes necessary to open each clip at the receiving end to permit a sheet to be properly located relatively to the clip. To effect this I provide a cam strip 61 (Figs. 1 and 6) along the inner edge of which the pin 47 rides and causes the movable jaw to open. This operation is illustrated by comparing the several positions of the clips shown in Fig. 6 in which figure the middle position shows one clip as just ready to be closed by its spring 51 upon a sheet a which has been carried to proper position by automatic means hereinafter described. As the pin 47 slips off from the lower end of cam strip 61, the spring 51 closes the clip with a snap so that, when the jaws are of the form illustrated in Figs. 6 and 8, the material will be slightly indented and firmly held. With the form of clip shown in Fig. 9 however, while the action of opening and closing the clip is the same, the sheets are held by more extended flat surfaces. This form of clip shown in Fig. 9 is preferred for material which should not be indented to any extent by the clips.

It being understood that there is an endless series of clips traveling along each side of the machine so as to grasp each sheet at or near its two upper corners, I will now proceed to describe the feeder for supplying the sheets. For present purposes of describing my invention it is sufficient to state...
that the sheets may be manually supplied one by one, to the feeder, but it is also to be understood that I may employ any suitable or preferred means for automatically supplying the sheets singly to the oscillating feeder which latter includes two arms 62 (Figs. 1, 4 and 5) secured to a rock shaft 63, said arms having vertically adjustable sliding extensions 64 which are connected by a feedboard 65 against the inner face of which the sheets are to be laid one by one. The rock shaft 63 has an arm 66 provided with a roll 67 which is actuated by a cam 68 fixed to a short shaft 69 having a worm gear 70 which is driven by a worm 71 carried by a shaft 72, the latter having a sprocket 73 connected by a chain 74 with a sprocket 75 secured to the main shaft 39. This mechanism causes the arms 62 and the feed-board 65 to oscillate from the position shown in Fig. 1 to a position which will carry a sheet to position so that its upper edge will be introduced between the open jaws of the clips which are then in position, as shown in Fig. 6, to be immediately thereafter closed upon the sheet. While the oscillating feeder might depend upon gravity for its return or outward movement, I preferably employ some means for insuring the return movement. In Figs. 1 and 2 I illustrate such means as comprising an arm 153 connected to the rock shaft 63, said arm having rod 156 which is actuated by a spring 157 operating against a collar 158 secured to the rod.

To support the lower edges of the sheets which are laid against the inner face of the feedboard 65, I provide chains 76 which, at their inner ends, are mounted upon idle sprockets 77 as shown by comparing Figs. 1 and 7. The sprockets 77 are loose upon a stud 78. The outer ends of the chains 76 are mounted upon sprockets 79 carried by shafts 80 which form the pivotal connections between arms 81 and 82 as shown by comparing Figs. 4 and 5 there is a pair of these jointed arms 81; 82 and, of course, a supporting chain at each side of the entrance end of the machine. The inner end of each upper arm 81 is mounted upon the stud 78 while the inner end of each arm 82 is pivoted to the frame as at 83. Each sprocket 79 has its hub formed with ratchet teeth 84 engaged by a pawl 85 (see Figs. 1 and 13), said pawl being carried by a hollow shae 86 which is loose on the stud 80. A spring 87 is suitably connected as indicated in Fig. 12 so as to have a tendency to keep the arm 88, one end of which is secured to the shae 86 and the other end being secured as at 89 to the feedboard. Each arm 82 has a chain 90 (Fig. 1) provided with an ear 91 connecting it to the feedboard 65, said chain being mounted upon sprockets 93, 94 carried by the arm. Since the parts at the right of the machine as shown in Fig. 5, which include the jointed arms and the supporting chain 76 are laterally adjustable, it is essential that at this side of the machine the connection of the strap 88 shall be adjustable. This is effected by means of a traveler rod 92 (Fig. 5) carried by the feedboard 65, the strap 88 being connected to said traveler rod. A shaft 95 is mounted in the two arms 62 as shown by comparing Figs. 1, 4 and 5. Said shaft carries the sprockets 94 for the chains 90 so that rotation of said shaft will actuate the chains to adjust the feedboard outwardly or inwardly along the arms 62, such movement of the feedboard also shifting the distance of the connected ends of the straps 88 from the center of oscillation of the feed-board. That is, when the feedboard is adjusted upwardly or outwardly for smaller sheets, the amount of movement transmitted through the straps 88 to the sheaves 86 and through the pawls and ratchets to the sprockets 79 and the supporting chains 66, will be increased. It is advisable to explain at this point that the upper edges of the sheets, regardless of the sizes of the sheets, shall always be carried to a definite position in order to be grasped by the clips. When an adjustment is effected for larger sheets, the supporting chains and also the guard chains 191, hereinafter described, are lowered. The larger the sheets, the nearer are their lower edges to the center of oscillation of the footboard, but it is desirable of course that the supporting chains 76 on which the lower edges of the sheets rest, shall travel at the same speed, or substantially the same speed, as the speed of movement of that portion of the arms against which the backs of the lower edge portions of the sheets bear. The pawl and ratchet and shae mechanism just described insures this proper movement of the supporting chains when the feed is occurring and the upper stretches of the supporting chains are moving toward the entrance end of the machine. These chains, however, which never move backwardly and the structure just described avoids any backward movement of the chains because when the feedboard swings outwardly or toward the position shown in Fig. 1, pawl 85 rides freely over the ratchet teeth 84.

The shaft 95, as shown in Figs. 1 and 5, passes through a bearing provided in a bracket 96. This bracket is fast to the rock shaft 63. The shaft 95 carries a pinion 97 which meshes with a gear 98 loose on shaft 63. The gear 98 may be provided with a handle 99 for manual operation, or it might be driven by power if necessary. Rotation of the gear 98 actuates the pinion 97 and of course actuates the shaft 95 to cause the chains 90 to shift the feedboard outwardly or inwardly as herein before described. To hold the parts in the adjusted positions, a
detent 100, pivotally connected to the oscillating bracket 96, engages the teeth of the gear 98.

As the sheets to be dried are frequently of quite stiff and heavy material, it is essential that if one or both of the corners should slip out from the clips, such sheet shall not fall down to any material extent, nor get out of position to continue on through the machine. For this purpose I provide two guard chains 101, which for the purposes of explanation have been referred to as the traveling floor, although in the operation, the sheets do not touch said floor unless they become loosened from the clips. These chains are, of course, adjustable vertically as well as to provide for width as hereinbefore described, and when the machine is running they are at such height that the lower edges of the sheets will not quite touch them. This is illustrated in Fig. 1 which shows a view of the sheets in suspended positions. Said figure also shows that the chains 101 are at a slightly lower level than the highest point of the supporting chain 76 where the latter chains pass around the sprockets 77. This relative height is also shown in Fig. 7. One sheet a depending from a clip in Fig. 6 is just leaving the chains 76. If now, a sheet having been gripped by a pair of clips and carried off from the high portion of the chains 76, should slip, the lower edge of that sheet or a corner of it would bear upon the guard chain or chains 101. If the size of the sheet is such that no portion of it remains between the jaws of a clip, after slipping, the upper edge of that sheet will simply tilt backwardly or forwardly and the sheet would then still stand substantially upright, leaning against one of the other sheets. Each chain 101 at its front end is mounted upon a sprocket 102 loose on stud 78 at one side of the sprocket 77. The other end of each chain 101 is mounted on a sprocket 103 loose on a stud 104 at the rear portion of the machine as shown by comparing Figs. 2 and 7.

A pawl 105 carried by sprocket 102 engages a ratchet 107 on the hub of sprocket 77. The chains 101 travel continuously at a very slow speed or, in other words, at the same speed of travel as the carrier chains. In order that the supporting chains 76 may travel at the same speed as the chains 101 when the feedboard has commenced to return, the pawl and ratchet connection just described has been provided. That is, when the chains 76 are not being caused to travel faster than the connections including the straps 88 hereinbefore described, because the feeder is swinging back, the chains 76 are being moved at the same speed as the chains 101 through the medium of the pawl 105 and ratchet 106. The chains 101 are driven by the following means. Composed with the sprockets 103 are sprockets upon which are mounted chains 107 (Fig. 2). Each chain 107 is driven through the medium of a chain 108. The sprockets carrying these chains are held at the proper distance apart by jointed arms 109, 110, the joint or pivot being indicated at 111. The arm 110 is pivoted at its lower end upon shaft 112. This arrangement of jointed arms and sprockets and chains is quite well-known in structures where it is desirable to transmit power from one relatively stationary point to another adjustable point. Of course, there is a structure of this kind at each side of the machine. A chain 113 is mounted on a sprocket compounded with the sprockets for the lower end of chain 109, and said chain 113 is mounted at its upper end on a sprocket on stud 114. Compounded with this last-mentioned sprocket is a gear 115 which meshes with a gear 116 secured to the shaft 36. 117 indicates a suitable deflecting idler.

When the sheets are released from the clips their lower edges drop onto delivery belts 118 (Figs. 2, 3 and 11) which are run at a higher speed than the carrier and guard chains in order that the lower edge of each sheet as it drops will be pulled out or advanced so that the sheet will lie down flat and be carried away by the belts 118. These belts are mounted at their inner ends on pulleys 119 which are loose on the studs 104. At their outer ends the belts 118 are mounted on pulleys 120 fast on shaft 121 which latter is mounted in bearings carried at the upper ends of uprights 122 pivotally supported at 123 and steadied or held by spacing arms 124, the inner ends of said spacing arms being mounted on the studs 104. As hereinafter described, the studs 104 shift vertically when the guard chains are varied in height, and this, of course, similarly raises or lowers the portions of the belts 118 on which the sheets drop. The belts 118 are driven by means of a belt or rope drive 126 mounted on a pulley 125 secured to the shaft 191 and passing around idlers 127, 128 (Fig. 2) onto a pulley 129 secured to the main shaft 39. The idler pulley 128 constitutes a belt tighter, it being mounted in an arm 130 pivoted at 131 and having a weight 132 connected to its outer end by a link 133.

I will now describe the means for adjusting the uprights 24 laterally and all of the parts carried by those uprights to provide for sheets of varying widths. Referring to Figs. 1, 2, 4 and 5 it will be seen that screws 134 extend into the feet or bases 25 of the uprights so that rotation of the screws will simultaneously adjust all of said uprights, the wheels 27 of the bases running on the tracks 28. Each of these screws 134 is connected by means of beveled gearing 135.
135 with a long shaft 136 extending substantially the full length of the machine. Chains 137 are mounted on sprockets carried by the screws 134, said chains at their upper ends being mounted on sprockets carried by upper screw shafts 138 the latter extending through threaded members carried by or secured to the upper top bar section or sections 29. This provides for simultaneous adjustment of the tops of the uprights 24, corresponding with adjustment for the lower portions thereof.

In practice, with a very heavy machine it is best to connect power to one of the shafts just described so that this adjustment above mentioned can be easily effected. For present purposes it is sufficient to state that the shaft 136 may have a square toothed ratchet 139 (Fig. 4) engaged by a reversible toothed pawl 141 carried by a hand lever 140. It is to be understood that the adjusting screws and their connections may be driven by means of power from the shafts 39 through any suitable manually controlled gearing.

The sprockets to support the chains 101 are carried by vertically adjustable frame bars 142 (Figs. 1, 2, 4 and 5). At one side of the machine these frame bars have lugs 143 which are internally threaded to fit vertical screws 144 mounted in bearings carried by relatively fixed portions of the machine, said screws being connected at their upper ends by beveled gearing 145 with a shaft 146, one end of which may have a crank 147. This shaft also however may, in practice, be driven by power from the shaft 39 through any suitable manually controlled gearing. The lower ends of the screws 144 are connected by beveled gearing 148 with shafts 149 extending transversely of the machine through the adjustable uprights 24. These shafts 149 are connected by beveled gearing 150 (Fig. 5) with vertical screws 151 fitting internally threaded ears 152 of frame bars 153 which are similar to the frame bars 142 at the other side of the machine. The members of the beveled gearing 150 which are carried by shafts 149 have, of course, a splined connection 154 with the shafts 149, said beveled gearing having, of course, the usual collar devices to cause them to slide along the shafts 149 to preserve their intermeshing engagement with the other members of the said beveled gearing 150.

Having described the operation of the different parts of the machine in connection with the explanation of the structure of such parts, further description of the operation of the machine as a whole is unnecessary.

Having now described my invention I claim:

1. A drier having a carrier provided with means for holding sheets of material in pendant positions, and a traveling floor or guard below the carrier to support any sheet that may become detached from the carrier, said guard being adjustable toward and from the carrier.

2. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling floor or guard below the carrier, and a feeder for supplying sheets singly and in upright positions to the carrier.

3. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling floor or guard below the carrier, and means for actuating the latter intermittently.

4. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling floor or guard below the carrier, and means for adjusting the width of the carrier and the traveling floor or guard.

5. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling support on which the sheets rest edgewise when being moved toward the carrier, and means for intermittently actuating said traveling support and holding the sheets substantially upright thereon.

6. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling support on which the sheets rest edgewise when being moved toward the carrier, and means for intermittently actuating said traveling support and holding the sheets substantially upright thereon, said traveling support comprising a pair of chains having means for intermittently moving them simultaneously with their supporting stretches traveling in a direction toward the carrier.

7. A drier having means for holding sheets of material in pendant positions, a traveling floor or guard for the sheets, and an intermittently actuated support and means for advancing the sheets singly with their lower edges bearing on said support.

8. A drier having a carrier provided with means for holding sheets of material in pendant positions, a traveling support adjacent one end of said carrier, means for advancing sheets singly while resting edgewise on said traveling support, and a traveling floor or guard beyond said support, said floor or guard being in a lower plane than the delivery portion of the support.

9. A drier having a series of stationary uprights and a series of adjustable uprights, a pair of carriers each having means for engaging sheets, one carrier being connected to be adjustable with said adjustable supports.

10. A drier comprising stationary up-
rights and adjustable uprights, a pair of carriers each having means for engaging sheets, means for feeding sheets to said carrier, said means including a pair of feeder supports, one of said carriers and one of said feeder supports being laterally adjustable with said adjustable uprights.

11. A drier having a carrier provided with means for holding sheets of material in dependent positions, a feeder comprising oscillating arms, a transverse board carried by said arms, endless supports for the lower edges of the sheets, and means for actuating the endless supports by the movement of the arms in one direction.

12. A drier having a carrier provided with means for holding sheets of material in dependent positions, a feeder comprising oscillating arms, a transverse board carried by said arms, endless supports for the lower edges of the sheets, means for actuating the endless supports by the movement of the arms in one direction and means for actuating the supports at a slower speed when the arms move in the other direction.

13. A drier having a carrier provided with means for holding sheets of material in dependent positions, a feeder supplying sheets singly to said carrier, said feeder comprising oscillating arms, a transverse board carried by said arms, endless supports for the lower edges of the sheets, and means for vertically adjusting said supports.

14. A drier having a carrier provided with means for holding sheets of material in dependent positions, a traveling support for delivering sheets from the discharge end of the carrier, and means for actuating said traveling support at a faster speed than the carrier to cause the lower edges of the sheets to be drawn out as the sheets are released by the carrier.

15. A drier having a carrier provided with means for holding sheets of material in dependent positions, a traveling floor or guard below the carrier, and a traveling support beyond said floor or guard and in substantially the same plane therewith.

16. A drier having a carrier provided with means for holding sheets of material in dependent positions, a traveling floor or guard below the carrier, a traveling support beyond said floor or guard and in substantially the same plane therewith, and means for causing said traveling support to move with a faster speed than that of the carrier and said guard or floor.

17. A drier having a carrier provided with means for holding sheets of material in dependent positions, a traveling floor or guard below the carrier, a traveling support beyond said floor or guard and in substantially the same plane therewith, and means for causing said traveling support to move with a faster speed than that of the carrier and said guard or floor, said traveling guard or floor and traveling support having means for simultaneously adjusting them vertically.

In testimony whereof I have affixed my signature, in presence of two witnesses.

WILLIAM S. KINSLEY.

Witnesses:

A. W. HARRISON,
A. F. RANDALL.