My invention relates to collapsible stairs wherein it is designed to provide a stairway which ordinarily is used in the upper stories of buildings adapted to extend from the floor of one story to the floor of the next story. While I am aware of other collapsible stairs that have been made heretofore, yet I believe that my collapsible stair constitutes features of primary importance which have not been used heretofore in so far as I know, and I have included in these features a particular means of operating the stair to fold the same into a very small compact state. It is a feature of my invention to provide a collapsible stair wherein a coil or band-like spring member is used which is secured to the jamb of the casing in the frame which fits into the upper floor and which is formed with an extending portion which is adapted to be connected to an arm which is pivotally attached to a second arm which is connected to a section of the stair.

It is also a feature of my invention to provide a particular fastening and adjusting means for the coil springs which is adapted to form the balancing or lifting springs held in the frame work which fits into the ceiling and by which my stair is adapted to be operated. This holding means includes a gear-like member which is adapted to engage a hook end formed on the spring and which permits the hook end of the spring to be engaged with the sprockets of the gear in different positions in a manner to increase or decrease the tension of the spring. Thus providing an adjustment for the stair so that the balancing spring may be readily and easily adjusted when it is desired. I have found this to be a very important feature in a practical folding stair of the nature hereinafter set forth.

I have also included a feature in my stair which is of importance and which includes a balancing spring means connected to the side of one of the sections of the stairs and adapted to operate with the rail which extends from one section to the other in a manner so as to assist in lifting and folding the sections of the stair when it is desired to fold the same into a compact state or to lift the same from the lower floor and fold it into the ceiling or at the upper floor.

A further object in my invention resides in adjustable arms which extend from the casing supporting the stair to the sides of the first stair section and which are adapted to carry the strain of the load of the stair when the same are extended into operating position. The adjustment of these arms is important as it is necessary that the arms be properly adjusted to hold the same extended to form a bracket arm means for carrying the load of the stair in the proper manner. These arms should operate in a manner so as not to interfere with the easy folding of the stair when a slight pull is exerted against the rail as one walks up the stairway. The adjustment is very easy and in such a manner as to permit the arms to be extended to the proper length.

These features, together with other particular details and objects and arrangement of the parts will be more fully and clearly set forth in the specification and claims.

In the drawings forming part of my specification:

Figure 1 is a perspective view of my stair in use.

Figure 2 is a perspective view of my stair folded into a collapsed state and showing the casing frame which is adapted to support my stair in a manner so that the same can be folded and shipped in this compact state ready to be inserted in the ceiling of a building so that it can be quickly set up.

Figure 3 illustrates a detail of the bracket supporting arms in side elevation.

Figure 4 is a longitudinal section through the same.

Figure 5 illustrates the adjusting gear for the spring balancers.

Figure 6 also illustrates the adjusting gear for the spring balancers.

Figure 7 is a detail partly in section, one-half of the same illustrating the washer and adjusting gear for the stair supporting arms illustrated in Figures 3 and 4.

Figure 8 is a section on the line 8—8 of Figure 7.

Figure 9 illustrates a detail of the lower end of the stair.

Figure 10 is a section on the line 10—10 of Figure 9.

Figure 11 illustrates an alternative form of my stair.

Figure 12 illustrates a detail of the supporting hinged upper end of my stair in section.
Figure 13 is an enlarged detail of a portion of my stair, as of the construction of the balancing spring and gears in Figure 11.

Figure 14 is a section through the pivot point of the arms supporting one of the sections of the stair illustrated in Figure 11.

Figure 15 is a side view of a link or rod member used in my stair. Figure 16 illustrates the eye-bolt for attaching one end of the rod member illustrated in Figure 15.

In the drawings I have illustrated my stair A in Figure 1 which appears of a practical and simple nature, yet which is provided with details of importance to cause the stair to properly operate to function in a manner to carry out the principles of my invention.

The stair A is provided with an upper section 10, an intermediate section 11 and a lower section 12. The lower section is provided with floor engaging rollers 13. These floor engaging rollers are adapted to be secured by a hollow rivet member 14 which is clearly illustrated in Figure 10. This simplified construction provides a strong and economical means for attaching the rollers to the lower end sections 12.

The upper section 10 is provided with a bottom or sheathing 15 which is secured to this section 10 in a manner to form a closure for the casing 16 which is of a size and construction to form the frame about the stair sections when they are folded together as illustrated in Figure 2. Thus the upper section 10 is folded up into the ceiling the closure 15 covers the opening to provide a neat and finished surface to the bottom of the casing 16 and stair A.

The section 10 is hinged to the section 11 at 18, while the section 12 is hinged to the section 11 at 19. When the stair sections fold together the section 11 is adapted to fold onto the section 10, while the section 12 is adapted to fold under the section 11. My stair is automatic in operation in folding and unfolding after it has been started and this is due to the balancing means which I will hereinafter describe.

The section 10 is adapted to be supported by the bracket arms B which are illustrated in detail in Figures 3 and 4. The bracket arms include the lower member 20 which is pivotally connected by the bolt 21 to the side of the section 10 by means of the spacer washer 22 which is formed of a frusto-conical nature thereby spacing the arm 20 away from the side of the section 10 to give the proper clearance. The other member 23 of the arm B is pivotally connected by the screw 24 to the casing 16 and through the link 25 which is held by the screw 26 to the casing. By means of the link 25 the arm B may be adjusted into the desired position by first placing the screw 26 through the end of the link 25 and then opening the stair into the position illustrated in Figure 1 and placing the screw 24 in position. Thus the link 25 assists to hold the upper end of the bracket arms B in position.

The portions 20 and 23 of the arm B are connected together by the adjusting gear 26 which is illustrated in detail in Figures 7 and 8 and which is provided with a flange portion 29 on one side which engages against the outer surface of the member 20, while a panel washer member 30 is held by the screw 31 into engagement with the outer surface of the portion 23 of the arm B. The inner surface of the gear 28 is hollowed out at 32 as illustrated in Figure 8 and thus sharp end portions or corners 23 are formed on the outer edge of the teeth 34 of the gear 28 so that when the screw 31 is tightened the flange washer 30 is caused to bear against the biting edges 33 of the gear teeth 34, thus holding the gear member 28 against rotation and in a set position.

The adjusting gear 28 is adapted to fit into longitudinally extending slots 36 formed in the members 20 and 23 and having rack teeth 37 formed on one side thereof which are adapted to be engaged by the teeth 34 of the adjusting gear 28.

To adjust the length of the arms B the screw 31 is loosened and by means of a slot 35 formed in the flange portion 29 of the gear 28, the gear is rotated in a manner to lengthen or shorten the bracket arms B. This adjustment is best made when the stair is in open position so as to draw the arms tant to support the sections of the stair 10, 11 and 12 extending in a straight line when extended as illustrated in Figure 1, so as to cause the arms B to carry the primary load of the stair. Thus the arms B take the major portion of the strain of the stair sections 10 in a manner is adapted the stair rigid and firm in operation and when a load is applied to the same. My stair will carry several people at one time.

I have provided balancing spring members 40 which are formed with a hook end 42 on the inner end of the coil of the spring which engages with the teeth of the gear 43.

These balancing springs are placed in the sides of the casing 16. The gear 43 is formed with a hollow inner surface 44 as illustrated in Figure 6 and a plate-like side 45 on one side from which project lugs 46. The gears 43 are held to the casing by means of screws passing through the openings 47 in a manner to hold the lugs 46 in suitable openings which have been drilled into the side of the casing 16. Thus by ordinary screws the gears 43 are held very rigidly and firmly to the casing 16.

The balancing spring members 40 are adapted to be connected to the lifting arms 45. I connect the outer end of the spring 40 with the arms 48 by forming the spring with
a twist in the end, as illustrated in Figures 11 and 13 at 49, and by means of the bolt 50 which extends through the arm 48 and the end of the spring 40. The arms 48 are formed with lugs which extend on each side of the spring to engage over the same and form a rigid connection with the bolt 50 between the arm 48 and the end of the spring 40.

To adjust the tension of the balancing springs 40 it is only necessary to disengage the hook end 42 of the spring 40 from the teeth of the gear 43, changing the position of the end 42 in relation to the teeth of the gear 43 so as to loosen or tighten the tension on the spring 40 when the spring is in operating position. It is therefore readily apparent that an easy adjustment of the balancing springs is provided so that the springs 40 may operate to balance the weight of the stair sections 10, 11 and 12 for folding the same. It is to be considered that the balancing springs 40 practically lift the sections of the stair A after the folding operation has been started so that the means of the easy adjustment of the springs 40 will be more apparent.

By the spacer members 22 the arms B are spaced away from the sides of the section 10 and permit me to provide a hand rail 52. This hand rail is connected to the member 53 which is secured to the side of the section 11 by means of the pivotal connection at 54 on one end, while the other end of the hand rail 53 is connected pivotally at 55 to the operating end of a balancing spring 56 which is held by an adjusting gear 43 to the side of the section 10, as illustrated in Figure 1. I provide the balancing gear 56 for the purpose of assisting in the lifting of the lower sections 11 and 12 so that in folding my stair it is only necessary for the operator to walk up the stairway until he has reached a point on the upper end of the stair section 10, holding on to the rail 52 and pulling upward on this rail slightly causes the sections 11 and 12 to fold upward onto the section 10 by means of the balancing spring 56. In fact the operation of folding the lower sections is practically automatic as soon as they have been started by a slight pull on the hand rail 52.

The hand rail provides an additional safety for my stair A so that the person walking up and down the stair can readily engage the hand rail to steady themselves and not interfere with the supporting bracket arms B in any way whatsoever.

In Figure 11 I have illustrated an alternative form of my stair wherein the hand rail constitutes a wire cable-like member 60 which is connected to the operating end 61 of the spring 56 as illustrated in Figure 11. The lower end of the cable 60 which forms the hand rail in this construction of my stair is connected to a single arm or member 62 which is rigidly connected to the side of the section 11. This hand rail and balancing spring member 56 operate in the same manner as the metal or wooden hand rail 52 but provides a cheaper construction. The hand rails 52 or 60 operate to carry the section 11 over the pivot center 18 to cause the same to fold. When the lower sections 11 and 12 have folded up onto the section 10 the balancing springs 40 then automatically lift the entire stair A in a manner to fold it up into the casing 16 as illustrated in Figure 2. I have thoroughly tried and tested my stair in a very practical manner and have supplied a large number of these stairs for actual use in a very successful manner.

In Figure 11 I have illustrated the arms 48 of a longer nature than the arms 48 in Figure 1 and the outer free end 48' of the same are adapted to pivotally connect at 64 with a second arm 65 which extends down to the pivot point 66 which is the same pivot point as the lower end of the operating arms B and held by the bolt 21. This construction has some advantages in the lifting of the stair sections and I desire to use this in carrying out my invention. In this construction one of the members of the arms B has a stop lug 67 which bears against the other member to prevent the portions 20 and 23 of the arms B from extending beyond center in one direction, as illustrated in Figure 11.

My features of my stair reside primarily in the adjustment of the balancing springs 40, the construction of the springs and the adjusting gear with the hook end on the spring and the twisted end of the balancing spring to engage the arms 48 flatwise so as to provide a compact construction of the parts of the operating members of the stair A and the balancing springs 56 in conjunction with the hand rail members 52 and 60, together with the general practically automatic operating of the folding or unfolding of my stair A, and it is apparent that the stair may be made of wood or metal without departing from the principles and features of my invention. I have found that the spacing of the arms B is important from the sides of the stair sections and this permits the hand rail to be properly positioned without danger of the hand rail scraping their hand on the operating members B. I also have shown that the particular adjustment by the gear 28 of the adjusting members B is of importance, together with the link connection 25 at the upper ends of the supporting members B which take the main strain of the load of the stair A. With these features I have provided a practical, useful and very desirable folding stair.
5. In Figures 15 and 16 I have illustrated the pivot end of the arm B or 20 is carried by the head of the bolt 21. This spacer washer 22 holds the arms B and 65 away from the side of the stair.

10. Extends up to the arm B and is adapted to pass through the eye-bolt 82 which is secured to the arm B. The free end 83 of the rod 80 is threaded and is adapted to be adjusted by the nut 84 so that the length of the rod 80 may be adjusted in a manner to provide the necessary rigid connection between the sections 10 and 11 when the stair is extended as illustrated in Figure 1. I prefer to provide two of the arms or rods 80, one on each side which are adapted to hold the stair more rigid when it is in use. When the stair is folded up the rod 80 will slide through the eye-bolt 82 to permit the folding of the stair into a compact state.

15. In accordance with the patent statutes I have described the principles of operation of my folding stair of which I have endeavored to illustrate the best embodiment thereof, and while I have shown a particular formation in the drawings I desire to have it understood that the same is only illustrative and that the invention can be carried out by other means and applied to uses other than those above set forth within the scope of the following claims.

I claim:

1. Folding stair sections, one adapted to fold upon the other, a pair of balancing spring members having a coil nature, and gear members adapted to engage and adjustably support the inner end of said balancing springs to adjustably balance said stair sections in the folding thereof.

2. A collapsible stair comprising sections adapted to fold in a short compact relation, a casing for supporting the sections together, a pair of adjustable load arms, balancing springs, and operating spring arms adapted to lift the stair sections after they have been started to fold in a manner to automatically collapse the stair sections into a compact state.

3. A folding stair including, a series of sections hinged together, balancing springs for lifting said sections automatically, means for adjusting said balancing springs by changing the axial position of the inner end of the same, a hand rail extending from one section to the other, and a balancing spring means adapted to operate said hand rail in a manner to lift a portion of said stair in the folding of the same.

4. A collapsible stair including, sections hinged together, adjustable load carrying arms pivotally connected together, rack and pinion adjusting means in said arms, and means for balancing and lifting said stair associated with said arms.

5. A collapsible stair including, a series of said sections, a closure panel carried by one of said sections, balancing and lifting springs for said stair, a gear member for supporting the inner end of each of said springs in a manner to permit ready adjustment of the same by changing the position of the inner end of said springs on said gear member, a hand rail member extending from one section to another, a balancing spring connected to one end of said hand rail, and means for adjusting the tension of said hand rail balancing spring.

6. Means for lifting a collapsible stair having upper and lower sections including, coil balancing springs having a free inner end, a gear for engaging the inner end to adjust the tension of said springs, and hand rail means for said collapsible stair including a balancing spring operable on one end of said hand rail means, whereby when said hand rail is operated to pull the same in an upward direction the lower sections of said stair are caused to fold and collapse on the upper section thereof and said balancing springs are adapted to automatically fold the entire sections of said stair together.

7. Means for lifting and supporting the upper and lower sections of a collapsible stair comprising a pair of adjustable load supporting arms, a pair of balancing springs, tooth members for adaptably holding the inner ends of said balancing springs, the operating ends of said balancing springs being adapted to be secured to lifting arms, hand rail means on the side of said stair extending from one section to the other, and a spring operating means attached to one end of said hand rail means having an adjustable spring tension adapted to be positioned with a tension to cause the lower sections of the stair to be lifted and folded after they are raised by engaging on the hand rail to pull the same over center of the upper sections whereupon the lifting balancing springs first mentioned are adapted to automatically close and collapse the stairs.

8. A collapsible stair including, a series of sections hingedly connected together, the lower section being adapted to fold under the intermediate section and the intermediate and lower sections being adapted to fold on the upper section of said stair, and adjustable lifting springs for automatically closing the stair sections into collapsed position, said lifting springs each including a gear member rigidly positioned in the casing and adapted to engage a hook end formed on the inner end of the spring members to permit the free adjustment of said lifting springs.

9. Spring means for automatically lifting the sections of a collapsible stair includ-
ing, a gear member, lugs formed on said gear member adapted to hold said gear member rigidly in the side of a casing for supporting a stairs, a spring having a hook end formed on the inner end thereof adapted to engage with the teeth of said gear member to adjust the tension of said spring by changing the position of said hook end for the purposes specified.

10. Spring balancing means for a collapsible stair adapted to operate to lift the entire folded sections of the collapsible stair including a gear fixed to the casing and a spring having its inner end hooked freely over the gear teeth, the operating end of said 15 spring being secured to lifting arm means, and a second balancing spring means connected to the side of the collapsible stair and adjustable in the same manner as said first mentioned spring, and a hand rail connected 20 to said second spring lifting means whereby the lower sections of the stair may be first lifted by said second spring means and then said first mentioned spring means will operate to automatically close said stair.

REINHOLD B. MARSCHEKE.