

[54] **FLIGHT OF STEPS AND A STAIRCASE
COMPRISING A FLIGHT OF STEPS**

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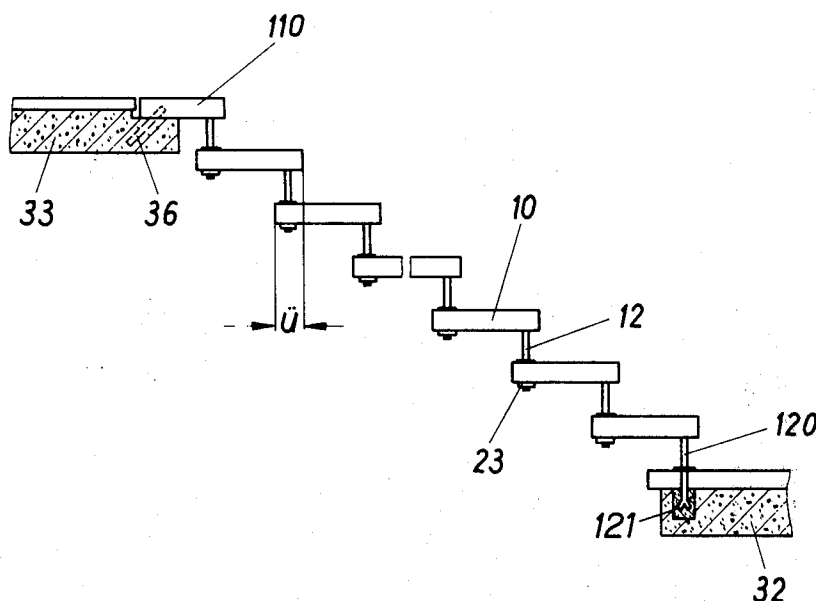
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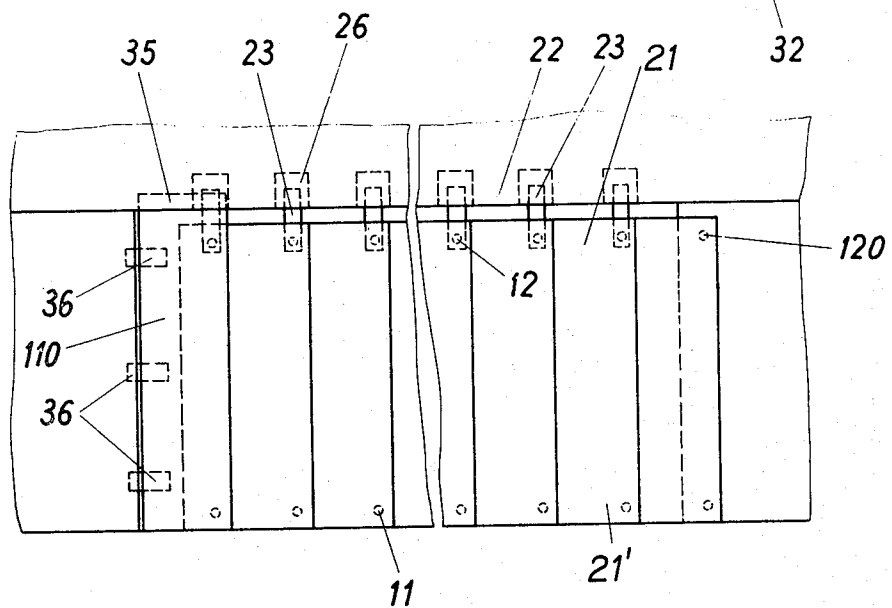
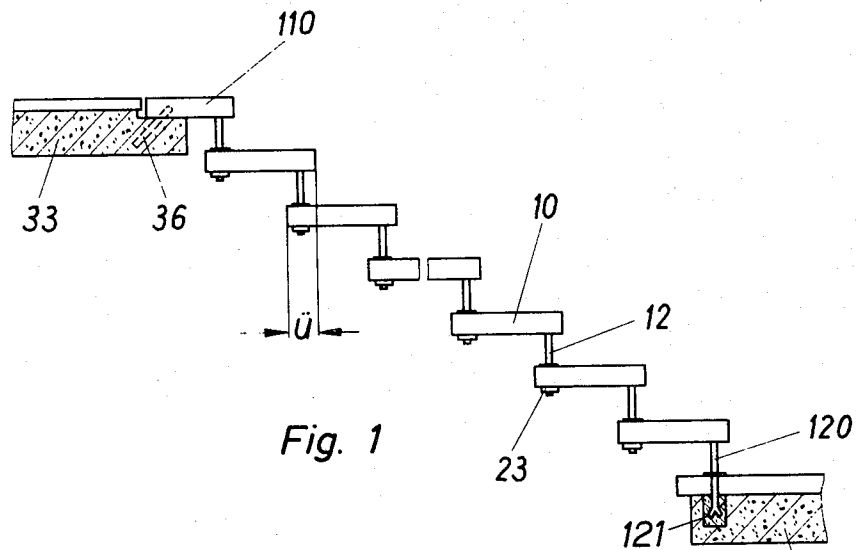
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ABSTRACT

A flight of free or cantilevering steps, anchored in a wall. The steps support one another by a set of spindles, rising from a rear end portion of one step to a front edge portion of the next upper step, each set including a spindle adjacent the wall and another spindle remote from the wall. For anchoring the steps to the wall the structure comprises a number of rigid bars, regularly distributed relative to the several steps, each bar having a portion which projects beyond the step and into the wall, into a recess of cylindrical shape, filled with strong mortar.

11 Claims, 6 Drawing Figures





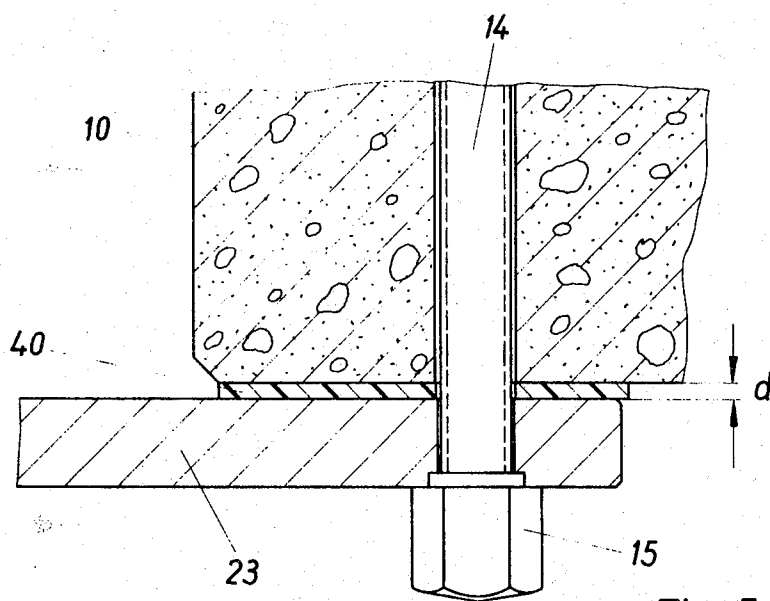


Fig. 5

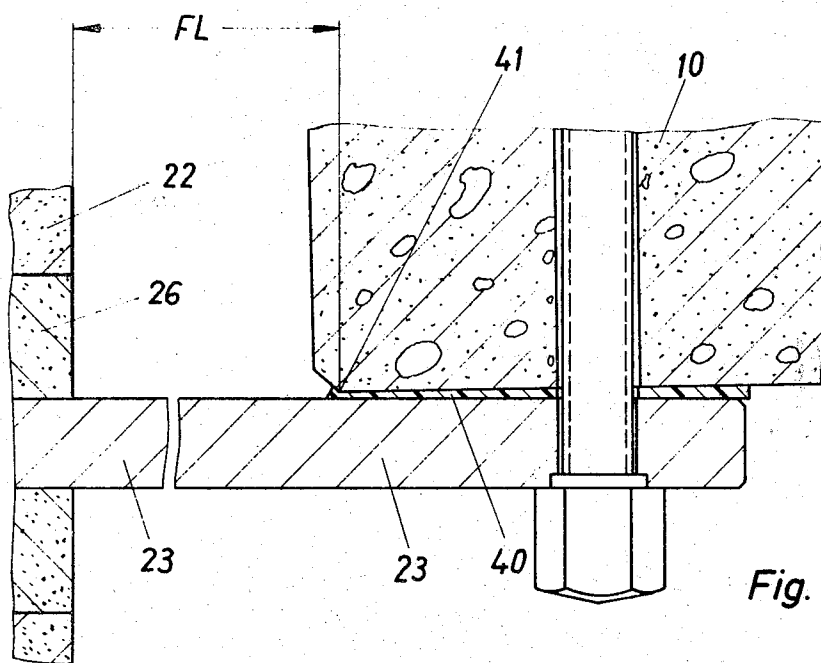


Fig. 6

FLIGHT OF STEPS AND A STAIRCASE COMPRISING A FLIGHT OF STEPS

This invention relates to a flight of steps having flat, mutually overlapping treads connected to one another by way of a respective pin or spindle at each tread end, the treads being also supported by the staircase wall.

Among the numerous known forms of construction of flights of steps, the applicants have in particular disclosed a flight of stairs in which the flat treads, which slightly overlap one another, are bonded-in by one end, and to a small degree only, to the staircase wall. At the points of overlap in the region of the other free ends connecting pins or spindles are provided between each pair of adjacent treads. The lowermost pin or spindle is supported practically only by the floor or landing. Suitable slots must be formed in the staircase wall for assembling a flight of steps of this kind. This is a very dirty procedure, and also is expensive. In the case of decorative masonry it is a difficult matter to cleanly insert the treads. The other hitherto known anchoring means for flights of steps of this kind have not been completely satisfactory in practice. The many problems and complex loads involved have not been accorded sufficient consideration. Also, assembly has not been sufficiently simple.

It is intended above all, through application of the present invention, to eliminate the above-mentioned drawbacks, while at the same time maintaining, as far as possible, the advantages inherent in the known forms of construction of flights of steps, and in particular to realise the advantages described below. The invention has the object of making available a flight of steps, which is of the type defined above, and which enables, with reliability and in a satisfactory manner, the complex loads to be sustained by and transmitted to the staircase wall and/or the ground, landings, and floors, while the assembly can be secured in position cleanly, that is to say without producing a large amount of dirt.

According to the invention there is provided a flight of steps having flat mutually overlapping treads connected to one another by way of a pin or spindle at each end of the respective treads, the treads being also supported by the staircase wall, characterised in that a step anchoring element is provided under at least alternate treads, the treads being spaced a short distance away from the staircase wall, each step anchoring element being of rectangularly prismatic shape, being located in the vicinity of the area of overlap of the associated tread with the adjacent higher level tread, and being secured to the associated tread by the corresponding pin or spindle in that each step anchoring element extends into a cylindrical bore drilled into the staircase wall, the bore having a diameter appreciably greater than the diagonal of the cross-section of the step anchoring element, each step anchoring element being secured in the bore by means of mortar, and the pin of the lowermost tread lying closest to the staircase wall being secured to the floor or landing in a manner such as to sustain tensile forces, and the uppermost tread being secured to the staircase wall such that it is prevented from turning, and/or being supported by and so attached to the upper landing or floor as to prevent the uppermost tread from being lifted off the upper landing or floor.

The two rows of pins so formed would, by themselves, result in too weak a flight of steps. A flight of steps which is very stable and easy to assemble may be

arrived at by arranging for the tread to be spaced a short distance from the wall, and by providing a step anchoring element under each tread end or, if the pins or spindles and the treads are of sufficiently stable construction, by arranging step anchoring elements under alternate treads. Each of the step anchoring elements should lie directly under its associated step and should extend into the staircase wall. However, this is not sufficient, because the loading conditions are very complex in the case of spindle or pin mounted flights of steps. In order to provide a flight of steps which can sustain a wide range of loads, and which will function with the required degree of reliability, the lowermost pin or spindle lying on the side of the staircase wall must also be capable of transmitting tensile forces to the floor or landing, as the case may be. The step anchoring element must also be suitably anchored in the floor or landing. Furthermore, measures must be taken to ensure that the turning forces applied to the uppermost tread or step are satisfactorily absorbed. This may be realised by clamping the step in the staircase wall in such a way that the step is prevented from being turned; this does not present any very great difficulties because in any case the floor or landing has to be connected to the staircase wall with a suitable skirting board. Alternatively, the tread may be simply set down on the landing and then be prevented from being lifted up by additional means, for example by means of obliquely positioned anchoring elements. All the applied forces will also be absorbed in this way. It would also be possible, if desired, to adopt both of these expedients together. As the step anchoring element is of rectangularly prismatic shape, it can be manufactured very cheaply, and installed in a very satisfactory manner, without cutting (chiselling) work on large additional supporting surfaces being necessary. The rectangular cross-sectional shape of the step anchoring element may be suitably selected to enable it to transmit, in a very satisfactory manner, the applied forces to light masonry, which can only sustain relatively low specific loads. The relatively large circular bore also contributes to this result, the bore being filled with a suitably high quality mortar. As the bore is sufficiently large, unavoidable tolerances in drilling and assembly are automatically compensated for; the manner in which the step anchoring elements are secured in the staircase wall remains unimpaired. Additional fixing parts can be dispensed with owing to the fact that the step anchoring element is secured in position at the same time as the fixing pins or spindle. Owing to the fact that the step anchoring element is positioned immediately under the step, the free lever arm at the step anchoring element is very short. However, this is an advantage for obtaining a flight of steps which is readily capable of oscillation and is satisfactory from the point of view of noise.

In order to be able to transmit the forces applied to conventional flights of stairs or steps in residential buildings into all the types of wall under consideration, the ratio of width to thickness of the cross-section of the step anchoring element should be from about 2:1 to about 3:1. The specific loads applied to the bonded-in elements, and the forces transmitted, will then be very favourable. According to particularly favourable embodiments, there are used flat (planar) iron elements of a width of 40mm and a thickness of 15 mm,

or, in the case of high quality material, of a width of 22 mm and a thickness of 10 mm.

According to one modification of the invention, in which only the short section located between the end of a step or tread and the staircase acts as a freearm, the step anchoring element is mounted under the step or tread without the provision of an insert, and is securely clamped in position by tightening the attachment screw with sufficient force. As the load applied at this point, which always lies at the rear end of the step or tread, is directed practically entirely from above, the step anchoring element forms a practically completely rigid unit with the step or tread in the vicinity of the latter.

However, it may be desired to damp the tread or step noise in a more effective manner than can be realised through the resilient metal step anchoring element. In this case a resilient insert can be placed between the step and the step anchoring element. Naturally, this must be taken into account when dimensioning the step anchoring element. It will be found particularly satisfactory if the thickness and resilience of these elastic inserts are so related to the flight of steps that, when normal loads are applied, the insert will not be completely compressed even at the area subjected to the greatest loading, while, when particularly great loads are applied, the free length of the step anchoring element will be shortened to the distance between the end of the step and the staircase wall. A high degree of damping of the tread noise will then be achieved when the use of the flight of steps is a normal one, and particularly when it is being used by children. However, when (for example) very heavy items of furniture are being moved over the flight of steps, the resilient insert will be completely compressed, and the step anchoring element will then act as though rigidly attached to the step. Accordingly, the free arm of the step anchoring element only has to transmit the particularly high load between the end of the step and the staircase wall; this is possible, even in the case of a relatively small cross-sectional area, because the lever arm has been shortened.

Whereas, in the case of all hitherto employed ways of assembling flights of steps, each connection point had to be specially plastered or pointed, the proposed manner of assembling a flight of steps can be carried out without any subsequent plastering work or decorative masonry being required, such subsequent work being rendered superfluous by fixing a circular collar or cover element to the step anchoring element. The diameter of this circular collar or cover element must be greater than the bore drilled in the staircase wall than the difference between this bore and the diagonal of the step anchoring element. The circular collar cover element will then automatically compensate all tolerances entailed in assembling the flight of steps or stairs and in drilling the bore in the staircase wall; even the edge portions of the bore will not then have to be drilled with a particularly high degree of cleanness.

Further features, characteristics, forms of construction and advantages of the invention will be apparent from the claims and from the following description of embodiments of the invention, made with reference to the drawings, in which:

FIG. 1 is a diagrammatic side view of a flight of steps;

FIG. 2 is a diagrammatic plan view of the flight of steps shown in FIG. 1;

FIG. 3 is a vertical cross-sectional view, somewhat enlarged in scale, of the subject matter shown in FIGS. 1 and 2, only two treads or steps being shown;

FIG. 4 is a cross-sectional view, on a larger scale, taken along the line 4 — 4 in FIG 3;

FIG. 5 is a vertical partial cross-sectional view taken through the corner of a step or tread, and illustrates the manner in which the step anchoring element is secured in position, a resilient insert being provided, and

FIG. 6 is a partial cross-sectional view, corresponding to that of FIG. 5, illustrating the conditions when particularly high loads are imposed on the flight of steps or stairs.

The first embodiment, illustrated in FIGS. 1 to 4, of the flight of steps according to the invention has a number of individual steps 10, which overlap one another in the regions indicated by U. In the region of the two ends of each step, connecting pins 11 and 12 are provided, each of which can be screwed a desired distance into a threaded sleeve 13 of an adjacent higher-level step, and can also be securely clamped to the adjacent lower-level step by means of a threaded pin 14 and a nut 15, with the interposition of discs 16 and 17. The steps 10 are very flat, and may for example consist of concrete ashlar, which is provided in its centre with a reinforcing structure 20. The end 21 of the step lying closest to the wall lies at a short distance A (for example of 5 cm.) from the staircase wall 22. From this end 21 a step anchoring element 23 extends toward wall 22, as shown under each of the free step 10; the step itself, with its opposite end 21', is free and cantilevering, as best shown in FIG. 3.

Advantageously, the step anchoring element 23 is shaped as a rectangular prism, and in this particular embodiment is constituted by a flat iron component of relatively great width and relatively small thickness. The ratio of width B to thickness D is 4:1.5. A cross-section of 40 mm. width and 15 mm. thickness is used, particularly for light masonry, such as hollow building blocks, pumice concrete walls or the like. These step anchoring elements 23 are, with the assistance of the attachment means constituted by the threaded pin 14 and the nut 15, directly screwed into place under the associated step 10. The step anchoring elements 23 are preferably very tightly screwed up to their associated steps 10, so as to ensure that the region up to the end face 21 of the step is securely clamped in position, and forms a practically rigid unit with the step 10. The free length up to the front surface 25 of the masonry will then be only very small. The step anchoring elements 23 extend into bores 26, formed in the wall of the staircase. These bores 26 have an appreciably greater diameter DB than the diagonal DS of the step anchoring element 23, and are drilled to a relatively great depth T. The diameter may for example be 66 mm., and the depth may amount to 120 mm., if the above-described step anchoring elements are used. In the course of assembly the space 28 defined by such a bore 26 is filled with a very strong, very rapidly setting mortar, after all steps 10 and the step anchoring elements 23 of the individual steps to be secured to the wall have been aligned. This method of attachment, in which the flat face lies horizontal and in which the step anchoring element is bonded in such a high quality mortar within a relatively large bore, both enables the unavoidable manufacturing and installation tolerances to be compensated, and also (and above all) enables the applied

forces, which are often considerable, to be transmitted in a favourable manner to the masonry, which is often relatively weak and can only sustain small specific loading. With a view to sealing off the bore 26, a circular cap 30 may be used, whose diameter DK is appreciably greater than that of the bore, this diameter DK being sufficiently large to ensure that all possible installation tolerances will be completely compensated. Therefore any separate plastering work or subsequent patching at the assembly points can be dispensed with. Further, diameter DK must be greater than the bore diameter DB by at least the difference between bore diameter DB and the diagonal DS of the step anchoring element.

This new way of suspending the steps would, however, be insufficient by itself to produce an absolutely stable and robust flight of steps or stairs. The lower most pin 120, the wall 22, must be securely fixed to the landing or floor 32 in such a manner as to be capable of resisting tensile forces, for example by means of a special anchoring rod or end 121 of this pin or by means of a threaded sleeve, secured in position by anchoring rods. If these measures are adopted, then the lower part of the flight of steps or stairs will be reliably supported. However, the upper part of the flight of stairs needs to be additionally securely attached to the parts or building structures surrounding it, that is to say to the staircase wall and/or to the landing or floor 33. With this in view, and as illustrated in FIG. 2, the end 35 of the uppermost step 110 is sunk a short distance into the staircase wall 22. In this position the uppermost step 110 is prevented from turning, for example by wedging it into a suitably formed slot. As can be seen in FIG. 1, and as is also applicable when the step 110 is clamped in position in the staircase wall, this step 110 will usually be at least partially laid on the floor or landing. If it is desired to dispense with the arrangement whereby the step 110 is anchored in the staircase wall, then oblique anchoring elements 36 may be provided, which engage both the step and the landing or floor 33, so that the tread 110 is prevented from being lifted. When these provisions are observed, the flight of stairs will be satisfactorily supported so as to sustain forces over a wide range.

These step anchoring elements 23 held by mortar in bore holes 26, attach the flight of steps to the staircase wall 22 in such a way as to sustain forces applied to the steps, the attachment being satisfactory from the point of view of vibration. If it is desired to further improve the behaviour in respect of vibration, in particular in respect to tread noise, then (as illustrated in FIG. 5) a resilient insert 40, made of rubber or of a suitable synthetic plastic material, may be interposed between the tread 10 and the step anchoring element 23. This insert 40 will further damp the unavoidable tread vibrations. It will be found particularly satisfactory if this resilient insert is so matched, in its thickness d and in its resilient properties, to the flight of stairs that compression will not occur under normal loading conditions. If, however, the flight of stairs is subjected to particularly great loads, for example if pianos, safes or the like are carried over it, then conditions would become similar to those illustrated in FIG. 6. The outer edge 41 of the tread 10 would be inclined to the greatest extent, and thus compress the resilient insert 40 in the vicinity of this point, so that the tread will now be supported at this point, by the step anchoring element 23. The effective free length of the step anchoring element 23 is reduced to

the dimension FI, as a result of which the moments are appreciably less than would be the case if the applied force was mainly introduced in the vicinity of the pins 12/14.

The step anchoring elements and, in particular, the attachment pins may be differently constructed. However, the embodiment illustrated is particularly satisfactory for most practical applications. In the case of very strong staircase walls, for example concrete walls, other cross-sectional shapes, and possibly smaller drill holes, may be employed (if the assembly expected tolerances are not too great), because the forces occurring in practice can be satisfactorily sustained in the case of such walls.

With a view to improving the maintenance of stocks and to being in a position to produce large numbers of the step anchoring elements for all practical applications, it is desirable to make the step anchoring elements of a very high quality material. While it is otherwise conventional practice for building construction purposes, to use a steel known as ST 37 for occasions when strong loads have to be sustained, a high quality steel such as ST 70 or ST 50-3 should be used for the step anchoring elements. Under normal conditions this steel is very difficult to weld. However, since for purposes of the present invention the step anchoring elements only have to be screwed into place, it is possible to use this kind of steel. Cross-sections of about 22 mm. width and 10 mm. thickness can then be used because, when a cross-section of such dimensions is selected, a screw-head 15 or a suitable nut can be satisfactorily retained in position. This kind of step anchoring element with a cross-section of such small dimensions would prompt the user to employ, in all instances, staircase wall bores whose diameter is 20, 30 or 50% larger than the diagonal DS of the cross-section of the step anchoring element. This would not lead to difficulties in the case of high strength staircase walls (such as those made of concrete), because the assembly tolerances obtaining could be very easily compensated for. However, in the case of staircase walls which can only sustain a very small specific loading, such comparatively small bores could lead to overloading. It is therefore preferable always to use relatively small step anchoring elements made of high quality material; to position the step anchoring element with its flat side extending horizontally; to select the staircase wall bores of differing size according to the particular practical application; and to fill these bores with a suitably high quality mortar. The step anchoring element, which has a relatively small surface area, will then initially apply the high specific load to the high quality mortar. As this mortar closely conforms to the shape of the surrounding material volumetric extent, the force transmitted to the material which has been charged into the bore will be distributed over a relatively large surface area. Consequently, no difficulties will be experienced even in the case of staircase walls which can only sustain small specific loads. The novel flight of steps has the following advantages:

1. There are only two supporting pins or spindles per step, which results in an improved appearance and in reduced expense.

2. The amount of overlap between the steps can be normal, and the steps can be thin and therefore of minimal weight, while at the same time the flight of stairs is unimpaired in practical use.

3. Economic production is ensured.

4. More rapid operation is made possible by dry assembly. No very large wall anchoring elements are necessary. The bore can be rapidly, cleanly and cheaply produced by means of conventional percussive drills. Filling and setting take place in a matter of minutes.

5. Assembly is clean, so that, particularly in the case of enclosed spaces, the flight of steps affords advantages in comparison with conventional step assemblies.

6. No subsequent work is necessary in the case of decorative masonry.

7. The surrounding masonry is subjected to extremely small loads, owing to the favourable manner in which the forces are transmitted.

8. There is a minimal transmission of noise owing to the use of resilient step anchoring elements, which, within certain limits, exercise a favourable sound damping effect. This minimal noise transmission can be further improved by the use of resilient inserts.

What we claim is:

1. A staircase leading from a bottom plane structure, such as a floor or a landing in a building structure, to a top plane structure such as a landing or a roof in said building structure, comprising;

a wall,

a plurality of steps upwardly spaced from one another, forwardly following one another, and laterally spaced a short distance from said wall, every step but the uppermost one having a rear edge portion overlapped by a front edge portion of the next upper step and the uppermost step having a rear edge portion overlapping a front edge portion of a top plane structure;

means for supporting the steps by one another, comprising sets of spindles rising from the rear edge portion of one step to the front edge portion of the next upper step, each set comprising two spindles, to-wit, a spindle adjacent the wall and another spindle remote from the wall;

means for holding the steps a short distance from the wall and comprising a number of rigid bars said number being no greater than the number of steps in said plurality of steps and said bars being regularly distributed relative to the plurality of steps, each bar having a generally rectangular cross-sectional shape, having a cross section smaller than and generally parallel to that of a step, and having a portion secured to an underside of one of the steps, adjacent the wall, in the respective rear edge portion, with aid of one of said spindles; a portion of each bar projecting from the step toward and into the wall, the wall having recesses, each receiving one of the projecting portions of said bars; and means in each recess for holding the projecting portion of the corresponding rigid bar, rigidly anchored to the wall bar.

2. A staircase according to claim 1 including means for anchoring the lowermost one of said plurality of steps to a bottom plane portion of a building structure adjacent said wall, comprising at least one spindle which has vertically spaced ends secured respectively to the lowermost step and to the bottom plane portion, and means on said spindle for enabling the spindle to sustain tensile as well as compressive forces between the respective step and the bottom plane portion.

3. A staircase according to claim 1 including means for anchoring the uppermost step of said plurality of

steps to a top plane portion of a building structure to effectively secure the uppermost step to the top plane portion comprising an edge portion of the uppermost step extending into the wall, the wall having an elongate recess adjacent the top plane structure receiving said edge portion; and means in said elongate recess for holding the uppermost step to the wall and for preventing it from turning.

4. A staircase according to claim 1 including means for anchoring the uppermost one of said plurality of steps to a building structure to effectively secure it to a top plane structure therein, comprising a set of rigid bars distributed along a rear edge portion of said uppermost step, secured to said rear edge portion, extending forwardly therefrom into the top plane structure, and secured to the latter.

5. A flight of steps, comprising;

a plurality of rigid steps upwardly spaced from one another and forwardly following one another, every step but the uppermost one having a rear edge portion overlapped by a front edge portion of the next upper step, the uppermost step having a rear edge portion disposed to overlap a front edge portion of a top plane structure, and every step having two ends separated by said rear edge portion and said front edge portion of the step;

means for supporting the steps by one another, comprising sets of spindles interconnecting the rear edge portion of one step with the front edge portion of the next upper step, each set comprising two spindles, one adjacent each end of the one step;

means for anchoring the steps to a wall, comprising a number of rigid bars, no greater than the number of steps in said plurality of steps, regularly distributed relative to the plurality of steps, each bar having a generally rectangular cross section smaller than and parallel to that of a step and each bar laterally extending from the respective step; and

means for firmly securing each rigid bar, along a side of its rectangular cross-section, to a lower surface of a step.

6. A flight of steps according to claim 5 in which the number of rigid bars is substantially one-half the number of steps, said bars being secured to alternate steps.

7. A flight of steps according to claim 5 in which every step has a cross-section which is approximately rectangular and has a ratio of width to thickness from about 2 to 1 to about 3 to 1.

8. A flight of steps, comprising;

a number of rigid steps upwardly spaced from one another and forwardly following one another, every step having two ends, every step but the uppermost one having, between said ends, a rear edge portion overlapped by a front edge portion of the next upper step, and the uppermost step having a rear edge portion disposed to overlap a front edge portion of a top plane structure;

means for supporting the steps by one another, comprising sets of spindles interconnecting the rear edge portion of one step with the front edge portion of the next upper step, each set including a pair of spindles, one adjacent each end of the one step; and

means for anchoring the steps to a wall, comprising a number of rigid bars at most equal to the number of steps and regularly distributed relative to the steps, each bar having a cross section smaller than

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that of a step, having a portion rigidly secured to one of the ends of the step and a portion laterally projecting from the step, and each of said rigid bars having a bore, one of said spindles extending through the bore; and

means for attaching the one spindle and the bar to the step in the area of said bore.

9. A flight of steps according to claim 8 wherein each of said rigid bars is clamped directly to a lower surface of a step having such a bar, by the one respective spindle.

10. A flight of steps according to claim 9 including resilient insert means interposed between each of said

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rigid bars and its associated step.

11. A flight of steps according to claim 10 wherein said spindles and said means for attaching one spindle to a step have intermeshing threads, and each of said resilient insert means is a pad of such thickness and elasticity that when normal loads are applied to the respective threads the insert is not compressed to its limit, and that when particularly high loads are applied the pad is compressed to such an extent that the free length of the anchoring element is shortened to the distance of the step from the wall.

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