Jan. 23, 1951 J. D. REID ET AL 2,539,327

CABINET FOR RADIO APPARATUS

Filed July 23, 1947 2 Sheets-Sheet 1

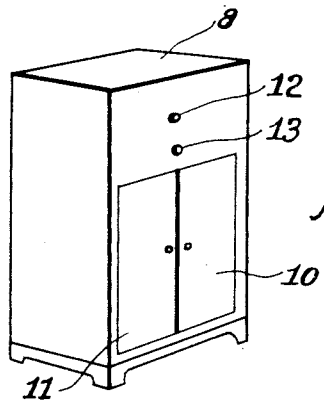


Fig. 1

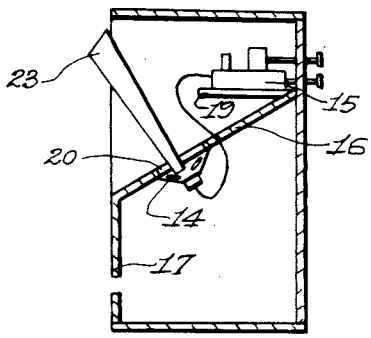


Fig. 2

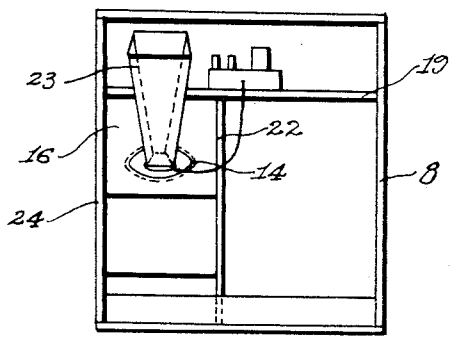


Fig. 3

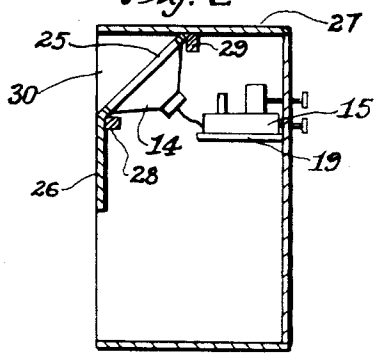


Fig. 4

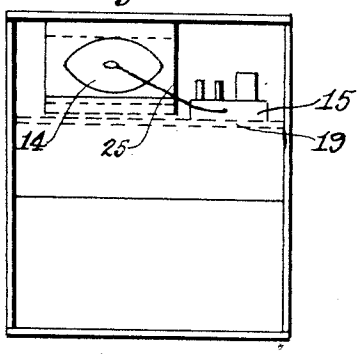


Fig. 5

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CABINET FOR RADIO APPARATUS

Filed July 23, 1947 2 Sheets-Sheet 2

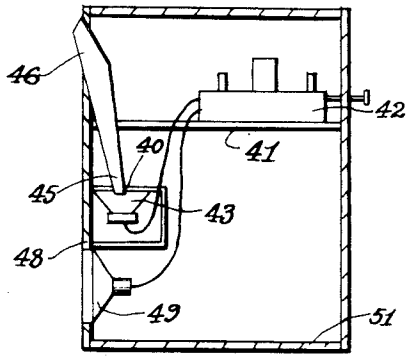


Fig. 6

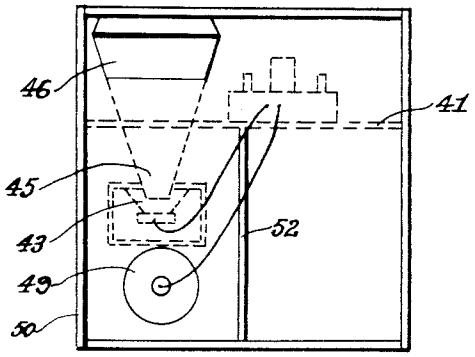


Fig. 7

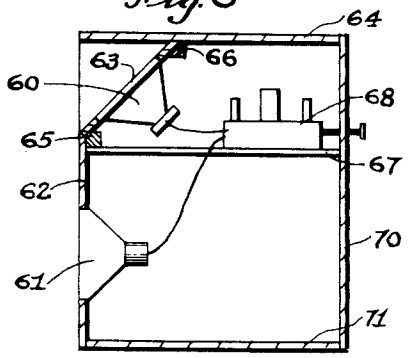


Fig. 8

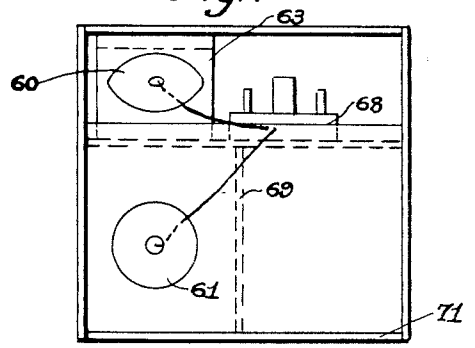


Fig. 9

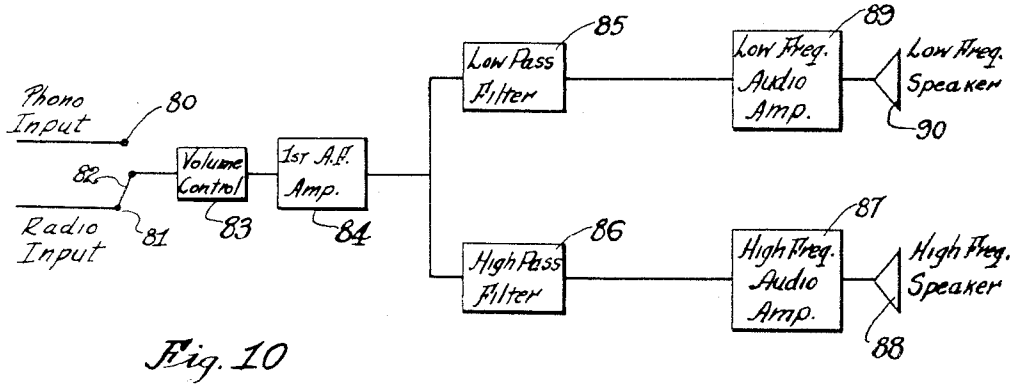


Fig. 10

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## CABINET FOR RADIO APPARATUS

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Application July 23, 1947, Serial No. 762,848

2 Claims. (Cl. 181—31)

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This invention relates to radio cabinets and especially to cabinets in which loud speakers are to be housed. In the construction of radio receiving sets and other sound reproducing apparatus the conventional practice has been to mount the speaker on the front panel of the radio cabinet so that the sound waves are directed through an opening in the panel into the interior of the room in which the cabinet is located. This design, while conventional, is not entirely satisfactory, both from the styling standpoint and because the sound emitted from the cabinet is unevenly distributed and appears to come from a point source. More specifically, with this conventional arrangement, the high audio frequencies are concentrated in a slender cone perpendicular to the front panel, thereby imparting an undesirable characteristic which is commonly known as "directivity" to the sound emanating from the cabinet.

An object of this invention is to provide a radio cabinet having a novel speaker arrangement therein, whereby the conventional grill on the front panel of the cabinet may be omitted and the front of the cabinet closed so that the cabinet may be constructed in the form of an article of furniture not obviously containing a radio receiver.

Another object of this invention is to provide a radio cabinet constructed and arranged to minimize the effect of a point source of sound.

A further object of this invention is to provide a radio cabinet so arranged that the sound waves emitted from the cabinet are more evenly distributed throughout the room in which the cabinet is placed than is possible with conventional cabinets.

A particular object of this invention is to provide a radio cabinet having a speaker arranged and constructed to direct sound waves to the rear of the cabinet in such a manner that the sound waves will be reflected from a boundary of the room adjacent the rear of the cabinet.

Another object of this invention is to provide a radio cabinet having a loud speaker operatively connected to a source of high frequency audio signals and directed upwardly and to the rear of said cabinet and a second loud speaker operatively connected to a source of low frequency audio signals and directed to the rear of said cabinet.

A still further object of this invention is to provide a sound reproducing system in which the interaction between the different sound frequencies is minimized.

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The novel features that we consider characteristic of our invention are set forth in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of four specific embodiments thereof when read in conjunction with the accompanying drawing, in which:

Fig. 1 is a perspective view of a radio cabinet constructed in accordance with the principles of the invention, illustrating the closed front exterior construction.

Fig. 2 is a sectional elevation of a device illustrating the preferred arrangement of the receiver chassis and speaker within the cabinet.

Fig. 3 is a rear view of the cabinet shown in Fig. 2 further illustrating the arrangement of the receiver chassis and speaker within the cabinet.

Fig. 4 is a vertical section from the front to the rear of a radio cabinet, illustrating a modified embodiment of this invention.

Fig. 5 is a rear view of the modified form shown in Fig. 4.

Fig. 6 is a vertical section from the front to the rear of a radio cabinet illustrating a third form of the invention including two speakers for directing sound waves to the rear of the cabinet.

Fig. 7 is a rear view of the cabinet of Fig. 6, further illustrating the arrangement of the receiver chassis and speakers within the cabinet.

Fig. 8 is a vertical section from the front to the rear of the cabinet, illustrating a second dual speaker arrangement within the cabinet.

Fig. 9 is a rear view of the modified form shown in Fig. 8.

Fig. 10 is a schematic diagram in block form of a radio circuit arrangement for use in connection with the dual speaker arrangements shown in Figs. 6 through 9.

Referring to Fig. 1, numeral 8 indicates generally a radio cabinet having a closed front construction in accordance with the principles of this invention. A pair of doors 10 and 11 may be provided to permit access to the storage space within the interior of the cabinet. It should be understood, however, that the operation of the reproducer is in no manner dependent upon whether or not these doors are open or closed. Suitable controls 12 and 13 for controlling the radio circuits may extend through the front wall as shown. It will also be understood that suitable decorative carving, paneling, inlaying or embossing (not shown) may be provided on the

doors 10 and 11 as well as the remainder of the cabinet.

In Fig. 2 a preferred arrangement of the loud speaker 14 and receiver chassis 15 within the cabinet is shown. A sound baffle 16 extends downward from the front to the rear of the cabinet. A second sound baffle 17 which contacts the lower edge of baffle 16 is employed to increase the baffle area. The baffle 17 may also constitute or be a part of the rear wall (not shown) if desired. A horizontal shelf 19 extending across the cabinet adjacent the upper end of baffle 16 is employed to support a radio receiver chassis 15 in the upper portion of the cabinet. Speaker 14 is mounted upon baffle 16 in any suitable manner as by means of conventional bolts (not shown). An opening 20 is provided in baffle 16 and an acoustic horn 23 is so positioned that the center of the loud speaker is covered by the throat of the horn. As shown, the horn preferably extends a short distance beyond the rear of the cabinet, and functions to conduct high frequency sound waves from speaker 14 in an upward direction to a location adjacent the rear of the cabinet. It will be understood that different types of horns may be used such as conical, parabolic, or exponential. Satisfactory results have been obtained, however, by use of a simple conical horn.

Referring to Fig. 3, baffle 16 is disposed within cabinet 8 in such manner that speaker 14 and horn 23 are located in the immediate vicinity of one of the end walls 24 of the cabinet. A vertical wall 22 is provided to separate the speaker from the rest of the cabinet. Wall 22 preferably extends vertically from shelf 19 to the bottom of cabinet and is used to support one side of baffle 16. In this arrangement it is necessary to use only the single additional vertical wall 22 which cooperates with the end wall 24 of the cabinet, baffle 16, and shelf 19 to provide a suitable baffle for speaker 14. It will readily be understood, however, that speaker 14 and baffle 16, together with horn 23 may be disposed in any suitable location along the longitudinal axis of the cabinet and need not be placed in the immediate vicinity of one end of the cabinet as shown. By placing the speaker in the location illustrated, maximum unbroken storage space is provided within the cabinet and the need for an additional vertical wall similar to wall 22 is eliminated. End wall 24 functions not only as an end wall of the cabinet, but also acts to increase the baffle area, thereby minimizing construction costs of a cabinet assembled in accordance with the principles of this invention.

As shown in Figs. 2 and 3, horn 23 preferably extends upwardly and outwardly from the interior of the cabinet so as to direct high frequency sound waves emitting from speaker 14 to the exterior of the cabinet in such a manner that the waves are first directed away from the listener and will be reflected upwardly upon contact with the wall of the room to the rear of the cabinet. While it has been found to be advantageous to direct the sound waves upwardly and to the rear in a direct substantially straight-line path, it will be understood that speaker 14 may be arranged so that it directs sound waves sidewardly, rearwardly or downwardly. If desired, a curved conduit may be used to conduct sound waves from the speaker to the rear of the cabinet.

In Figs. 4 and 5 there is shown an alternative embodiment of the invention in which the speaker 14 is mounted in the upper rear corner of the cabinet and which eliminates the need for a horn. While the preferred embodiment of the invention utilizes the horn construction as shown in Figs. 2 and 3, it has been found that suitable results may be obtained by mounting the speaker as shown in Fig. 4. Such a mounting is advantageous in that it provides for a maximum storage space within the cabinet. Speaker 14, which is inclined upwardly and to the rear of the cabinet, is preferably supported by a baffle 25 which in turn is mounted on vertical wall 26 and horizontal wall 27 by means of a pair of suitable rails 28 and 29, which may be secured to the cabinet by means of screws, glue or in any suitable fashion. An opening 30 is provided in rear wall 26 to permit passage of sound waves from the speaker to the exterior of the cabinet. The baffle 25, the top wall 27, and the back wall 26 are constructed to provide a continuous baffle. While it is preferable to place the opening in the rear wall of the cabinet, it will readily be understood that the opening may be provided in the upper wall of the cabinet rather than the rear wall or openings may be provided in each such wall for the passage of sound waves from the cabinet. A horizontal shelf 19 serves to support the radio chassis 15 as shown.

In Figs. 6 and 7 an alternative embodiment of the invention is shown, illustrating an arrangement of a pair of speakers and the radio chassis within the cabinet. A support housing 40 mounted on the rear wall 48 of the cabinet functions as a sound baffle and serves to fixedly position an upwardly facing speaker 43 within the cabinet. Conventional bolts (not shown) or any other suitable means may be employed to mount the speaker to the support. A horizontal shelf 41 serves as a support for a radio chassis and functions to seal the upper and lower portions of the interior of the cabinet from each other. An acoustical horn 46 extends through openings provided in shelf 41 and housing 40 with the throat 45 of the horn formed by the opening in the housing 40. As shown, throat 45 opens into the upwardly extending acoustical horn 46, the upper end of which is curved to direct sound waves upwardly and to the rear of the cabinet. Horn 46 may be mounted to the rear wall 48 by means of clamps (not shown) or may be supported from shelf 41, or both, and may be sealed about the opening in shelf 41 to avoid leakage of low frequency sound waves through the opening.

The radio cabinet, as shown in Figs. 6 and 7, includes a rear wall 48 extending in a vertical direction from the horn 46 to the bottom of the cabinet. A second wall 52 extending downwardly from shelf 41 to the bottom of the cabinet cooperates with rear wall 48 and the side walls of the cabinet to fully enclose a space around a second speaker 49 which is mounted on the rear wall of the cabinet. Speaker 43 is, of course, located within this space, but is separated therefrom by means of support housing 40 which completely encloses the space around the speaker. As is well known in the art, the enclosure in which speaker 49 is placed may be considered as an infinite baffle which insures a good low frequency response.

As stated in connection with Figs. 2 and 3, the horn may be conical, parabolic or exponential. Best results, however, have been obtained by use of an exponential horn which is noted for its uniform frequency characteristics and sharp low frequency cut-off, which cause the horn to act as a high-pass filter. In this manner, sound waves having a greater frequency than the cut-off fre-

quency of the horn are passed through the horn while those having a frequency less than the cut-off frequency of the horn are filtered out and are prevented from passing therethrough. It has been found desirable to provide a horn having a cut-off frequency of approximately 250 cycles per second or less.

The radio receiver chassis 42 shown in Fig. 6 is constructed and arranged to provide a source of low frequency audio signals, and a separate source of high frequency audio signals. Speaker 43 is operatively connected to the source of high frequency audio signals while speaker 49 is operatively connected to the source of low frequency audio signals. As shown in Figs. 6 and 7, both the high and low frequency speakers 43 and 49 are disposed within the cabinet in the immediate vicinity of the end wall 50 of the cabinet. In this arrangement it is necessary to use only the single additional wall 52 which together with baffle 41, wall 50, and bottom 51, seals off the speaker compartment from the rest of the cabinet. It will be understood, however, that speaker 43, acoustical horn 46 and speaker 49 may be disposed in any desirable location along the rear wall of the cabinet and need not be placed in the immediate vicinity of end wall 50 as shown. In the embodiment illustrated, end wall 50 functions not only as an end wall of the cabinet, but also acts as one side of the enclosure in which speaker 49 is placed. In this manner, construction costs of the cabinet are minimized.

In Figs. 8 and 9 there is shown a further alternative embodiment of the invention in which a speaker 60 is mounted in the upper rear corner of the cabinet, and which eliminates the need for a horn. While the use of a horn as shown in Fig. 6 is preferred, it has been found that suitable results may be obtained by mounting the speaker as shown in Fig. 8. It will readily be apparent that the embodiment shown in Fig. 8 is advantageous in that it requires less space and is less costly to produce. A second speaker 61 is mounted upon the rear wall 62 of the cabinet within a sealed enclosure as set forth in connection with Figs. 6 and 7, speakers 60 and 61 being operatively connected to suitable sources of high and low frequency audio output respectively. Speaker 60, which is mounted on a baffle 63 is inclined upwardly and to the rear of the cabinet and is preferably retained in contact with vertical wall 62 and the horizontal wall 64 by means of a pair of suitable rails 65 and 66. A horizontal shelf 67 serves to seal off the upper portion of the interior of the cabinet from the lower portion thereof, and also to support the radio chassis 68. A vertical wall 69 together with the bottom 71, the front 70, the rear wall 62 and shelf 67 serve to provide an enclosure in which speaker 61 is housed, with the beneficial results already noted.

In Fig. 10 there is shown a schematic diagram in block form of a radio receiver system providing two independent circuits which constitute sources of relatively high and low frequency audio output. Such circuits are known in the art and do not constitute a part of this invention. The circuit shown is merely illustrative of one circuit which may be employed in connection with this invention. A particular circuit which may be employed in connection with this invention is fully shown in our U. S. Patent No. 2,474,191. As shown, the circuits may be operatively connected to either a phonograph input 80 or a radio input 81 by means of a suitable switch 82.



Signals entering switch 82 pass through a volume control 83 and a first audio frequency amplifier 84 from which they are conducted to a low-pass filter 85 and a high-pass filter 86. The cut-off frequencies of these filters may be of any desired frequency such as 250 cycles per second. Signals having frequencies above the cut-off frequency of filter 86 are conducted to an audio amplifier 87 from which they are conducted to a loud speaker 88, whereby the signals are converted to sound waves. Signals having a frequency below the cut-off frequency of filter 85 are conducted to audio amplifier 89 and thence to loud speaker 90 whereby they are converted to sound waves.

In the assemblies shown in Figs. 6 through 9, speakers 49 and 61 are connected to a source of low frequency signals, for example, signals having a frequency less than 250 cycles per second, while speakers 43 and 60 are connected solely to a source of high frequency signals which may be considered, for example, to be signals of a frequency in excess of 250 cycles per second. The speakers 14 of Figs. 2 through 5 are, of course, connected to sources of both high and low frequency signals.

In operation, the radio cabinet is normally positioned with its rear wall adjacent but slightly spaced from a wall of the room in which it is placed. High frequency sound waves from speakers 14, 43 and 60 are directed upwardly and to the rear of the cabinet and are reflected upwardly and outwardly into the room by the wall adjacent the rear of the cabinet. Low frequency sound waves from speaker 14 upon striking the wall of the room adjacent the speaker are dispersed through devious paths and do not tend to travel upwardly and outwardly into the room in a straight-line path as do the high frequency sound waves. The low frequency sound waves emitted by speakers 49 and 61 are to a large degree separated from the high frequency sound waves emitting from speakers 43 and 60, and enter the room through paths of their own choosing.

It is known that high frequency sound waves normally travel in a substantially straight-line path while low frequency sound waves do not so travel. It will readily be understood, therefore, that high frequency waves will be reflected upwardly in the direction of the ceiling of the room and will then be reflected from the ceiling of the room and dispersed to greater extent than is the case with a conventional loud speaker arrangement. More specifically, the high frequency waves are directed upwardly and to the rear of the cabinet, while the low frequency waves are directed primarily to the rear of the cabinet. Since it is the high frequency sound waves which are largely responsible for the "directivity" of conventional radio receiver sets, and since there has thus been provided a radio cabinet constructed and arranged to provide a maximum dispersion of the high frequency sound waves, the effect of "directivity" has been greatly reduced.

It will be observed that there has thus been provided a novel radio cabinet and speaker construction incorporating the features of maximum storage space, a closed front panel which need not be opened when the radio is operated, and a construction which directs the sound waves emitting therefrom in a direction upwardly and rearwardly from the front of the cabinet, whereby the sound waves are reflected upon contact

with objects such as the wall of the room to the rear of the cabinet. In this manner, the sound waves emitted from the cabinet reach the listener through devious paths, thereby greatly minimizing the effect of a point source of sound as compared to that emitted by conventional radio cabinet and receiver arrangements.

It will also be observed that the intermodulation between high and low frequencies normally incident to audio amplifiers and speakers with conventional systems which reproduce the entire audio range will be greatly diminished in a dual channel system as described herein.

While this invention has been shown and described in four embodiments thereof, it will be understood that various modifications and changes may be made therein coming within the scope of the appended claims.

What is claimed is:

1. In a sound reproducing device to be positioned adjacent the wall of a room, a cabinet having an acoustically closed front wall normally presented to a listener, vertically extending side walls, top and bottom walls, and a rear wall normally presented to said room wall, an upwardly inclined baffle extending from said rear wall to said top wall, a horizontally disposed baffle extending from said rear wall to said front wall for dividing said cabinet into upper and lower acoustically insulated compartments, openings in said rear wall above and below said horizontal baffle, respectively, for permitting the emission of sound from said compartments, an opening in said inclined baffle, a loud speaker mounted upon said inclined baffle with the mouth of said speaker in registry with said baffle opening, said speaker mouth facing said upper compartment opening in a direction upwardly and rearwardly of said cabinet whereby sound waves from said speaker are projected against said room all in a direction upwardly and rearwardly of said cabinet, a second speaker mounted upon said cabinet rear wall and near one of said end walls with the mouth of said speaker in registry with said lower rear wall opening whereby sound waves from said speaker are projected against said room wall in a direction horizontal and to the rear of said cabinet, a vertically disposed baffle extending from said bottom wall to said horizontally disposed baffle and between said second speaker and the other of said end walls, a frequency selective network for providing audio frequency signals of a predetermined minimum frequency operatively connected to said first speaker, and a frequency selective network for providing audio frequency signals of a predetermined maximum frequency



operatively connected to said second speaker, the maximum frequency of the audio signals furnished by said second-mentioned network being no greater than the minimum frequency of the audio signals furnished by said first-mentioned network.

2. In a sound reproducing device to be positioned adjacent the wall of a room, a cabinet having an acoustically closed front wall normally presented to a listener, vertically extending side walls, top and bottom walls, and a rear wall normally presented to said room wall, an upwardly inclined baffle extending from said rear wall to said top wall, a horizontally disposed baffle extending from said rear wall to said front wall for dividing said cabinet into upper and lower acoustically insulated compartments, openings in said rear wall above and below said horizontal baffle, respectively, for permitting the emission of sound from said compartments, an opening in said inclined baffle, a high-frequency loud speaker mounted upon said inclined baffle with the mouth of said speaker in registry with said baffle opening, said speaker mouth facing said upper compartment opening in a direction upwardly and rearwardly of said cabinet whereby sound waves from said speaker are projected against said room wall in a direction upwardly and rearwardly of said cabinet, a low-frequency speaker mounted upon said cabinet rear wall and near one of said end walls with the mouth of said speaker in registry with said lower rear wall opening whereby sound waves from said speaker are projected against said room wall in a direction horizontal to the rear of said cabinet, and a vertically disposed baffle extending from said bottom wall to said horizontally disposed baffle and between said low-frequency speaker and the other of said end walls.

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