July 22, 1947. W. F. SANDS 2,424,506

PERMEABILITY-TUNED SHORT-WAVE SPREAD-BAND RECEIVER

Filed Oct. 24, 1942 2 Sheets-Sheet 1

Fig. 1.

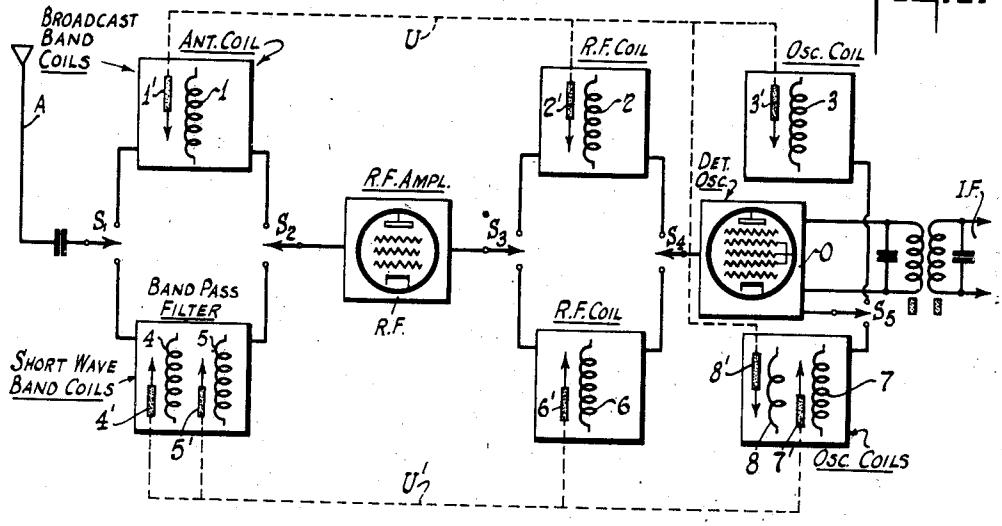
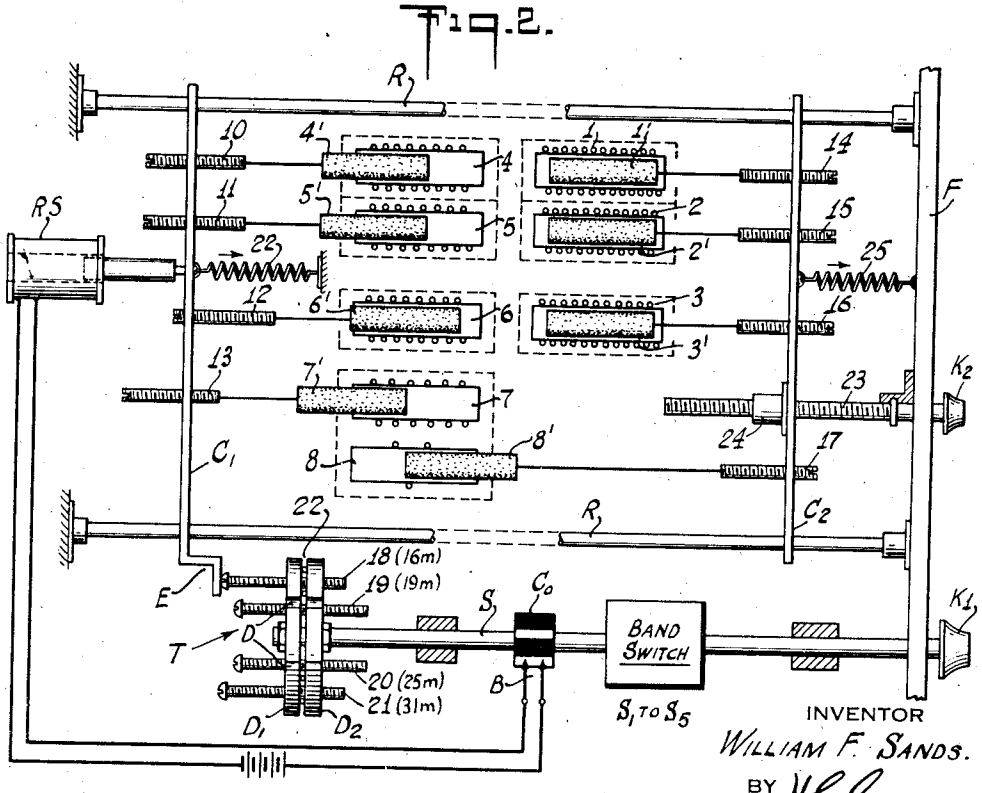


Fig. 2.



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Fig. 3.

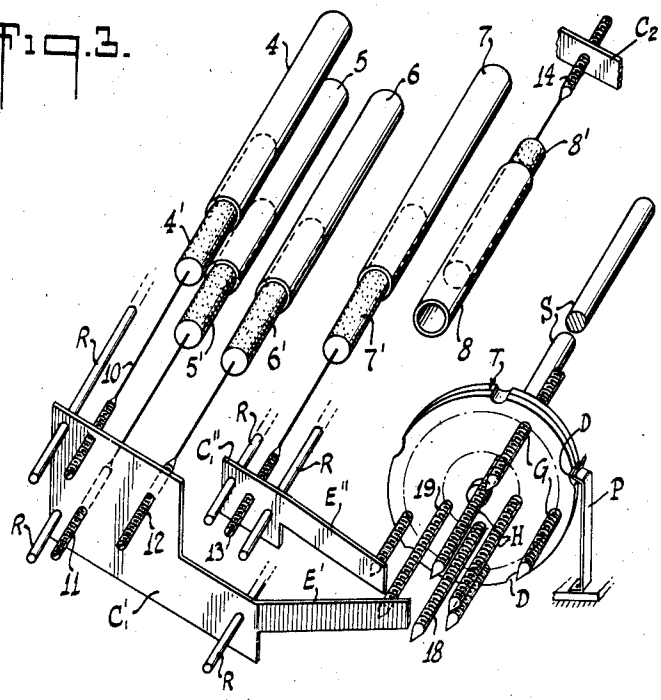
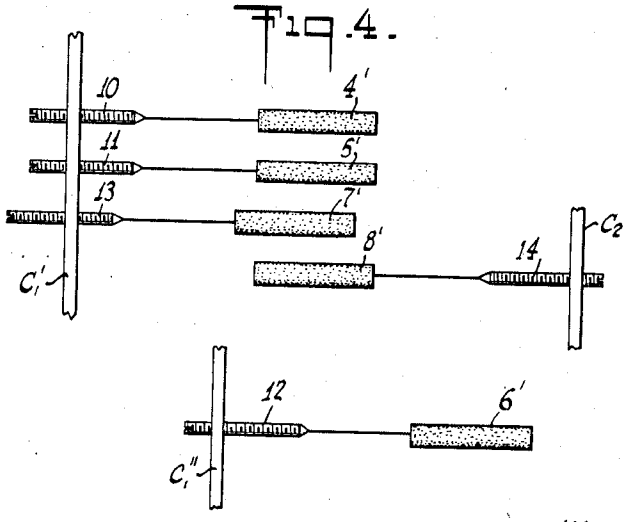


Fig. 4.



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PERMEABILITY-TUNED SHORT-WAVE SPREAD-BAND RECEIVER

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Application October 24, 1942, Serial No. 463,194

9 Claims. (Cl. 250—40)

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The present invention relates to a simplified permeability-tuned short-wave spread-band receiver, and more particularly to tuning mechanism for such receivers.

In conventional permeability-tuned short-wave receivers it is customary to tune all signal frequency circuits, as well as that of the oscillator, across each of the spread-bands. This is usually accomplished by the use of a separate set of shunt coils across the variable tuning inductances for each spread-band to be covered. Thus, for a superheterodyne receiver covering the present standard broadcast band and four of the international short-wave bands, with single tuned circuits in both the antenna and radio frequency stages, six continuously tunable and twelve fixed (but adjustable) cores and coils are required, or a total of eighteen permeability tuned or adjustable coils. If somewhat improved image attenuation were desired, particularly in the high frequency bands, a dual-circuit arrangement in either the antenna or radio frequency stage is usually employed. This would entail the use of eight tunable and sixteen fixed cores and coils.

In accordance with the present invention the number of tunable coils and cores required for satisfactory operation on the broadcast and the four customary short-wave bands may be reduced from eighteen to eight, i. e. three for the broadcast band, four for the short-wave band setting and one for short-wave band-spreading.

It is therefore one of the objects of the invention to provide a simplified tuning system which will give the same, or superior, electrical performance with the elimination of a large number of the coils hitherto used. This is accomplished by providing a set of four short-wave coils which are utilized for all of the short-wave bands, the particular band desired to be selected being determined by the setting of their respective iron cores to the center-frequency of such band.

It is another object of the invention to have only the oscillator circuit tuned across each short-wave or spread-band.

Another object is to provide a turret mechanism for selectively setting the several cores of the short-wave coils including the oscillator core to definite stops for each of the bands, these stops corresponding to the center-frequencies of the respective bands.

A further object is to effect the simultaneous control of the band-setting turret mechanism and the customary band-switch to provide automatic operation of the band setting means.

Other objects of the invention are to improve

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generally the simplicity and efficiency of permeability-tuned short-wave spread-band receivers and to provide such a receiver which is not only reliable in operation but capable of economical manufacture and assembly.

The novel features characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and mode of operation together with further objects and advantakes thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing in which

Fig. 1 represents in the form of a block diagram so much of the circuit of a permeability-tuned spread-band receiver of the superheterodyne type as is necessary for a proper understanding of the present invention;

Fig. 2 is a view showing the several coils and cores and the tuning mechanism employed for setting the short-wave cores to predetermined positions and for tuning the receiver through both the broadcast and short-wave bands;

Fig. 3 is a view in perspective of a portion of Fig. 2 showing the short-wave cores carried by two separately movable carriers instead of the single carrier as in Fig. 2; and

Fig. 4 is a diagrammatic showing of a further modification of the short-wave core and carrier arrangement.

Referring first to the block diagram of Fig. 1, which discloses diagrammatically only so much of the receiver system as is pertinent to the present invention, the circuit shows a first signal frequency or radio frequency stage R. F. followed by a first detector-oscillator O as is customary in the superheterodyne type of receiver.

The coils operative in the broadcast band are designated **1**, **2** and **3**, and are respectively the antenna coil, the radio frequency coil and the oscillator coil. The coils operative in the several short-wave bands are designated **4**, **5**, **6**, **7** and **8**, and are respectively the coils (**4**, **5**) constituting the band-pass filter network, the radio frequency coil, the oscillator band-setting coil, and the tuning or band-spreading coil. A band switch comprising the elements S_1, S_2, S_3, S_4 and S_5 serves to selectively connect into circuit, between the signal collector or antenna A and the I. F. portion of the receiver, the broadcast band coils **1** to **3** or the short-wave coils **4** to **8**.

When receiving signals in the broadcast band, tuning is accomplished in the usual manner by actuating the iron cores **1'**, **2'** and **3'** associated with respective broadcast band coils, the cores be-

ing adjustable in unison, as indicated by the dash line U. However, when receiving signals in any one of the short-wave bands, by suitable mechanism to be described hereinafter, the iron cores 4', 5', 6' and 7' are selectively moved in unison, as indicated by the dash line U', to one of four center-frequency positions, the selected center-frequency being that of the short-wave band desired to be received. Band-spread tuning within the selected band is then accomplished by adjustment of the auxiliary iron core 8' in the oscillator circuit which may be controlled by the same means U which actuates the cores for the broadcast band. The band-spread tuning means above referred to forms the subject matter of my U. S. Patent No. 2,406,260 dated June 18, 1946.

Although a single tuned circuit is all that is necessary between the antenna and the radio frequency stage when receiving signals in the broadcast band, it is desirable when receiving high frequencies, such as in the short-wave bands, to provide a band-pass filter in order to improve image attenuation.

The output of the detector-oscillator includes the usual I. F. transformer network which feeds into an I. F. amplifier, followed by a second detector, audio amplifier and sound reproducer, not shown, as well known in the art. Since the remainder of the circuit does not form any part of the present invention, further description thereof will not be given.

The mechanism employed for and the manner of tuning in any one of the short-wave bands will now be described in connection with Fig. 2. It is assumed first that the band switch S_1 to S_5 has been operated to connect into circuit the several short-wave coils 4 to 8. By suitable means to be described hereinafter the respective cores 4' to 7' associated with the band-pass filter network, the radio frequency circuit and the oscillator are adjustably set in an automatic manner to the center-frequency of the particular band which is desired to be received. Subsequently by the sole adjustment of the auxiliary iron core 8' of the oscillator the entire station selection within the desired band is accomplished.

In Fig. 2 which discloses a practical embodiment of the mechanism for adjusting the short-wave cores to the respective center-frequencies, there is provided a first carriage C_1 which carries the several short-wave cores 4' to 7' through the intermediary of the screw members 10 to 13 to which the cores are attached. Manipulation of such screw members provides initial adjustment of the cores. A second carriage C_2 is provided for carrying, through the intermediary of the adjusting screws 14 to 17, the cores 1' to 3' for the broadcast band and also the auxiliary or band-spread tuning core 8'. Two or more slide rods R, the ends of which are mounted in suitable brackets, are provided whereby the two carriages C_1 and C_2 are capable of being slidably supported thereon.

A turret mechanism T is positioned adjacent an extension E of the carriage C_1. The turret consists of a pair of disc members D_1 and D_2 affixed to one end of a shaft S. A plurality of adjustable stops in the form of screws 18 to 21 arranged in a circle are carried by the discs. In order that the screw adjustments once made may be maintained the discs are urged in opposite directions of rotation by suitable means such as a coil spring 22 interposed between the discs. Each adjustable screw or stop corresponds to the center-frequency of a predetermined one of the

short-wave bands, so that for example, screw 18 may be operative to adjust the cores to the center-frequency of the 16 meter band, screw 19 to the 19 meter band and screws 20 and 21 to the 25 and 31 meter bands, respectively. The control shaft S for the turret mechanism carries also the band switch elements S_1 to S_5 of Fig. 1. A commutator device C_0 for actuating a retracting solenoid RS for the carriage C_1 is also carried by the turret control shaft. The commutator may be incorporated within or form an integral part of the band switch, or else may constitute a separate element as shown.

In operation, when it is desired to select a predetermined short-wave band, the control shaft S is rotated by means of the knob K_1 to successive positions as determined by the detents D in the periphery of one of the disk members cooperating with a pawl P (shown in Fig. 3). At a definite position of the shaft the solenoid RS will be energized by closure of its circuit by the commutator C_0, to draw in its armature which is connected in a suitable manner to the carriage C_1 so that the latter is retracted to the left as viewed in the drawing, in opposition to the action of a spring 22. Upon the arrival of the turret adjusting screw to its proper position, the solenoid circuit will be broken by the arrival of an insulating portion of the commutator under the brush contacts B, enabling the carriage to return to the right under action of the spring 22. The position to which the carriage is returned will be determined by the particular adjusting screw which has been moved into the path of the carriage extension E. In such adjusted position of the carriage the several cores will have been moved to their respective center-positions for one of the short-wave bands, in this instance, the 16 meter band, as illustrated in the drawing.

A second carriage C_2 is mounted to slide on the carrier rods R at the other end thereof. This carriage supports through the intermediary of the adjusting screw 17 the auxiliary core 8', adjustment of which effects band-spread tuning within the shortwave band which is being received. Any suitable means may be utilized for slidably adjusting the carriage C_2, such as the threaded shaft 23 cooperating with the internally threaded bushing 24 affixed to the carriage. One end of the shaft is extended through the front panel F of the receiver and has the operating knob K_2 affixed thereto. A spring 25 serves to urge the carriage C_2 to the right thereby taking up any play that may be present between the shaft 23 and bushing 24.

The second carriage C_2 may also carry the adjustable cores 1' to 3' for the broadcast band by way of adjusting screws 14 to 16. The adjusting shaft 23 and its operating knob K_2 may then be utilized to tune the receiver within the broadcast band, it being noted that the auxiliary core 8' although moved in unison with the cores 1' to 3' is ineffective during reception in the broadcast band, the short-wave coils having been switched out of circuit by the band switch S_1 to S_5.

In order to provide proper tracking between the oscillator circuit and the other tunable circuits of the receiver the several short-wave cores may be differently arranged and disposed on the several carriages or sub-carriages. Two preferred embodiments for effecting this result are disclosed in Figs. 3 and 4. In each of these figures the main carriage C_1 for the cores is split into two separately-moving sections or sub-carriages C'_1 and C''_1 which operate against a double set of ad-

justable stops G and H arranged in a concentric manner on the rotatable turret T, as shown, or if desired the stops may be arranged instead in a radial manner. Extension members E' and E'' from the sub-carriages are adapted to engage only the respective stops of sets G and H.

In Fig. 3 the signal frequency cores 4', 5' and 6' are shown mounted on the sub-carriage C'1 and the main oscillator core 7' is mounted on the other sub-carriage C''1 so that the entire tracking problem is resolved merely into setting the two concentrically arranged sets of screw stops for the proper signal and oscillator frequencies of each short-wave band.

According to Fig. 4, the cores 4' and 5' for the bandpass circuits, which are assumed to normally track with the oscillator, and the main oscillator core 7' are mounted on the subcarriage C'1 whereas the core 6' associated with the circuit which normally does not properly track with the oscillator is mounted on the sub-carriage C''1. For the sake of simplicity the carriage C2 which carries also the cores for the broadcast band is shown in Figs. 3 and 4 only partially for the purpose of illustrating the attachment thereto of the spread-band tuning core 8' which is associated with the oscillator circuit. A variation of Fig. 4 would be the mounting of the oscillator core 7' on the same carriage C''1 with the core 6' of the radio frequency stage.

Although the receiver has been described as one adapted to receive any one of the four international short-wave bands, namely 16, 19, 25 and 31 meters, it will be understood that the invention is not limited thereto but that other frequency bands may be chosen.

While I have shown and described certain preferred embodiments of the invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of the invention, as will be understood by those skilled in the art.

What I claim is:

1. In a permeability-tuned receiver capable of receiving signals in a plurality of short-wave bands, a plurality of tunable circuits having each a solenoid winding and a magnetic tuning core movable therein to inductively tune the respective circuits, means for automatically adjusting the several tuning cores in unison to a selected one of a plurality of predetermined positions which correspond respectively to the center-frequencies of the several short-wave bands, and means operable independently of the first-mentioned means and without disturbing the center-frequency positions of the band-selecting cores for effecting band-spread tuning within each of said short-wave bands.

2. In a permeability-tuned receiver capable of receiving signals in the broadcast band and in a plurality of short-wave bands, a first set of cores effective to tune the receiver in the broadcast band, a second set of cores effective to tune the receiver in the short-wave bands, band switch mechanism for changing over from one to the other of said bands, means under control of the band switch operating mechanism for automatically setting the short-wave tuning cores to predetermined positions corresponding respectively to the center-frequencies of the several short-wave bands, and other means for effecting band-spread tuning within each of said short-wave bands, said other means being operative in unison with the broadcast band tuning cores.

3. In a receiver adapted to receive signals in a plurality of short-wave bands, a plurality of permeability tuned circuits the coils of which are each provided with a movable tuning core, a common slidably mounted carrier for all of said cores, a turret device provided with a plurality of adjustable stops, one for each band, constructed and arranged to selectively adjust the common carrier to a position such that the cores will tune the respective circuits to the center-frequency of the selected short-wave band, an auxiliary coil included in one of said circuits, an auxiliary tuning core movable with respect to said auxiliary coil to effect band-spread tuning within each of said short-wave bands, a slidably mounted carrier for said auxiliary core, and a control member for operating the latter carrier.

4. In a radio receiver adapted to receive signals in a plurality of short-wave bands and provided with at least one signal frequency circuit and a local oscillator circuit, a movable iron core associated with each of said circuits for adjusting the frequency thereof, means upon operation thereof for automatically and selectively adjusting the several iron cores in unison to any one of a plurality of predetermined positions, said core positions determining the respective center-frequencies of the bands to which the signal frequency circuit is tuned and the respective frequencies to which the local oscillator circuit is tuned, and an auxiliary iron core associated with the oscillator circuit and movable independently of the other cores for effecting band-spread tuning of the receiver within the several short-wave bands.

5. In a radio receiver adapted to receive signals in a plurality of short-wave bands and provided with at least one signal frequency circuit and a local oscillator circuit, a movable iron core associated with each signal frequency circuit, a main and an auxiliary movable iron core associated with the local oscillator circuit, means upon operation thereof for automatically and selectively adjusting the several iron cores except the auxiliary core of the oscillator circuit to any one of a plurality of predetermined positions, said core positions determining the respective center-frequencies of the bands to which the signal frequency circuit is tuned and the respective frequencies to which the local oscillator circuit is tuned by its main iron core, and means upon operation thereof to move the auxiliary core independently of the other cores for effecting band-spread tuning of the receiver within the several short-wave bands.

6. In a radio receiver adapted to receive signals in a plurality of short-wave bands and provided with at least one signal frequency circuit and a local oscillator circuit, a movable iron core associated with each signal frequency circuit, main and auxiliary iron cores associated with the local oscillator circuit, a slidable carrier for the several iron cores except the auxiliary iron core for the oscillator circuit, a second slidable carrier for the latter core, means upon operation thereof for automatically and selectively adjusting the first slidable carrier to any one of a plurality of predetermined positions, each such position determining the respective center-frequencies of the bands to which the signal frequency circuit is tuned and the respective frequencies to which the local oscillator circuit is tuned by its main iron core, and second means upon operation thereof for independently moving the second carrier for effecting band-spread tuning of the receiver within the several short-wave bands.

7. Tuning mechanism for a radio receiver adapted to receive signals in a plurality of short-wave bands and which is provided with at least one signal frequency circuit and a local oscillator circuit, comprising a movable iron core associated with each of said circuits for adjusting the frequency thereof, a slidably mounted member arranged to carry the several cores, means having a number of adjustments corresponding to the number of short-wave bands adapted to selectively adjust said slidable member to predetermined positions such that for each position the signal frequency circuit is tuned to the center-frequency of a different one of the bands and the local oscillator circuit is tuned to a different predetermined frequency, an auxiliary iron core associated with the oscillator circuit for effecting band-spread tuning of the receiver within the several short-wave bands, a second slidably mounted member arranged to carry said auxiliary core, and means for imparting sliding movement to the latter member.

8. Tuning mechanism for a radio receiver adapted to receive signals in a plurality of short-wave bands and which is provided with at least one signal frequency circuit and a local oscillator circuit, comprising a movable iron core associated with each of said circuits for adjusting the frequency thereof, a slidably mounted member arranged to carry the several cores, a rotary turret device having a number of adjustable elements corresponding to the number of short-wave bands adapted to selectively adjust said slidable member to predetermined positions such that for each position the signal frequency circuit is tuned to the center-frequency of a different one of the bands and the local oscillator circuit is tuned to a different predetermined frequency, an auxiliary iron core associated with the oscillator circuit for effecting band-spread tuning of the receiver within the several short-wave bands, a second slidably mounted member arranged to carry said auxiliary core, and means for imparting sliding movement to the latter member.

9. Tuning mechanism for a radio receiver adapted to receive signals in the broadcast band and in a plurality of short-wave bands, comprising at least one signal frequency circuit and a local oscillator circuit for the broadcast band and at least one signal frequency circuit and a local oscillator circuit for the short-wave bands, a band switch for changing over from one to the other of said bands, a movable iron core associated with each of said circuits for adjusting the frequency thereof, a slidably mounted member arranged to carry the several cores of the short-wave circuits, a rotary turret device having a number of adjustable elements corresponding to the number of short-wave bands adapted to selectively adjust said slidable member to predetermined positions such that for each position the short-wave signal frequency circuit is tuned to the center-frequency of a different one of the bands and the local oscillator circuit is tuned to a different predetermined frequency, an auxiliary iron core associated with the short-wave oscillator circuit for effecting band-spread tuning of the receiver within the several short-wave bands, a second slidably mounted member arranged to carry said auxiliary core and the broadcast band cores, and means for imparting sliding movement to the latter member which serves also to tune the receiver through the broadcast band.

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