[0013] An advantageous embodiment of the apparatus of the invention provides that a memory unit is associated with the microprocessor and correction values for the phase are stored in the memory unit as a function of the frequency of the oscillation. Especially, the correction values for the phase are accessible in the memory unit in the form of a table or in the form of one or more functions. The latter case occurs, when additional process variables, which influence the phase-frequency characteristic of the feedback electronics, e.g. temperature at the location of measurement, are taken into consideration.

[0014] In order to assure an optimal operation of the apparatus of the invention, the microprocessor assures, for example, that the function f(ν) assumes a constant value over the entire working range. The constant value can be, for example, 0°. Depending on the application, the sum of the phases of feedback electronics and microprocessor can, however, also exhibit a constant value different from zero. In principle, the constant, which represents the sum of the phases, can assume any value between −180° and +180°. By this embodiment, it is, for example, possible, to react to conditions changed by foam at the measuring site. Equally is it possible to distinguish the foam from the liquid medium being measured, given certain prerequisites. Additionally, a freely changeable phase is—as already mentioned above—an indispensable precondition for the measurement of viscosity.

[0015] Consider the following example: A limit value switch is installed as an overfill safeguard in a container, in which a liquid, strongly foaming, measurement medium is stored. In such a case, the limit switch must issue a switching signal as soon as the foam comes in contact with the oscillatable unit and not only after the oscillatable unit reaches into the liquid medium. In order to assure a reaction of the limit sensor to the foam, the sum of the phases of the feedback electronics and the microprocessor is set to a value different from zero, e.g. to +50°. Furthermore, an optimized adjustment for the case that the limit value switch is installed as a run-dry protection can utilize a sum set e.g. to −20°. In such a case, the switching point of the limit switch is set such that the foam is ignored.

[0016] According to an advantageous further development of the apparatus of the invention, an input/display unit is provided, on which the function f(ν) can be pre-set. In this way, it is possible to choose, depending on application, a density, viscosity or foam measurement, without having to make any hardware changes in the individual components of the electronics part. It is to be noted that data communication can occur without the necessity of on-site input, for example over a field bus.

[0017] Preferably, the feedback electronics provides the microprocessor with a periodic, preferably rectangular signal, which is used by the microprocessor for determining a correction value for the phase. In this way, it is achieved that the signal coming from the microprocessor does not have to be converted A/D and filtered in the frequency domain. Instead, the signal coming from the microprocessor can be processed in the time domain. For this reason, a more cost-favorable microprocessor can be used, since no A/D conversion with a computationally intensive filtering in the frequency domain is needed.

[0018] Especially, the microprocessor executes the following steps: In a first step, the microprocessor determines on the basis of the edges, e.g. on the basis of the rising edges, of the rectangular input signal, the frequency of the oscillation circuit; subsequently, the microprocessor matches the determined frequency with the corresponding, stored, correction value for the phase; in a third step, the microprocessor arranges for the output of an output signal with the phase corrected as determined in step two. In this way, a regulating of the oscillating circuit to the predeterminable, or predetermined, phase-frequency characteristic is obtained essentially in real time.

[0019] Additionally, it is provided that the microprocessor determines the frequency over plural periods of the input signal, and conducts a frequency weighting. It is found in practice that the microprocessor, depending on the quality of the signal, does not always determine the same frequency over a plurality of periods. At this point, a frequency weighting is initiated. Should it for application technical reasons be reasonable to force the oscillatable unit to lower frequencies, then the microprocessor can output the lowest of the frequencies measured in the last periods. Of course, also other application technical factors can be taken into consideration by corresponding presetting of the microprocessor. For instance, a frequency averaging can be performed over plural periods, or the largest determined frequency is selected and fed to the booster mentioned below, for the amplification.

[0020] In an advantageous further development of the apparatus of the invention, an amplifier circuit (→booster) is provided, via which the output signals of the microprocessor are fed to the driver unit for the oscillatable unit.

[0021] A preferred embodiment of the apparatus of the invention provides that the microprocessor additionally assumes the tasks of the evaluation unit and determines the reaching of the predetermined fill level or determines and signalizes the viscosity, the density or the foam formation of the medium being measured.

[0022] An advantageous further development of the apparatus of the invention provides that the feedback electronics provides the microprocessor with a signal which is amplitude-proportional to the input signal. This embodiment is important, when the medium being measured is a solid medium. Thus, e.g., in the case of the SOLIPHANT switch available from the assignee, the amplitude change, and not the frequency change, is evaluated for the purpose of detecting and/or monitoring the fill level.

[0023] In addition, a sensor for the measurement of a process variable, e.g. a temperature sensor, is provided, which supplies the microprocessor with information regarding the process variable, e.g. regarding temperature, and the microprocessor considers the influence of the process variable in the providing of the correction value for the phase.

[0024] The invention will now be explained in further detail on the basis of the drawings, the figures of which show as follows:

[0025] **FIG. 1 a** block diagram of an apparatus of the invention, and

[0026] **FIG. 2 a** graphic presentation of phase, corrected phase, and amplification plotted against frequency.

[0027] **FIG. 1** is a block diagram of the apparatus of the invention in the form of a limit switch. The apparatus **1**