March 5, 1940. G. H. STRAIN 2,192,668

SCREEN

Filed May 2, 1938 3 Sheets-Sheet 1

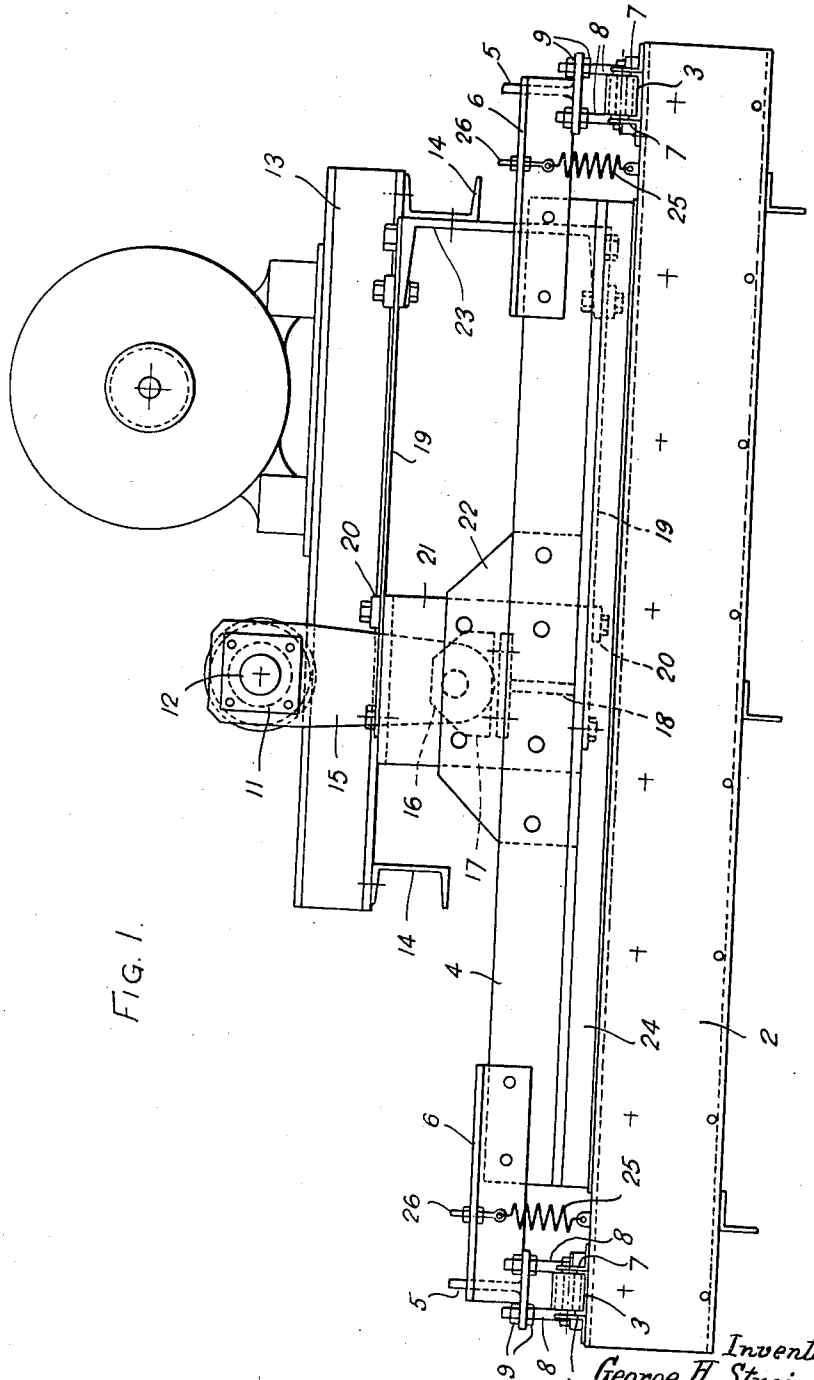


FIG. 1.

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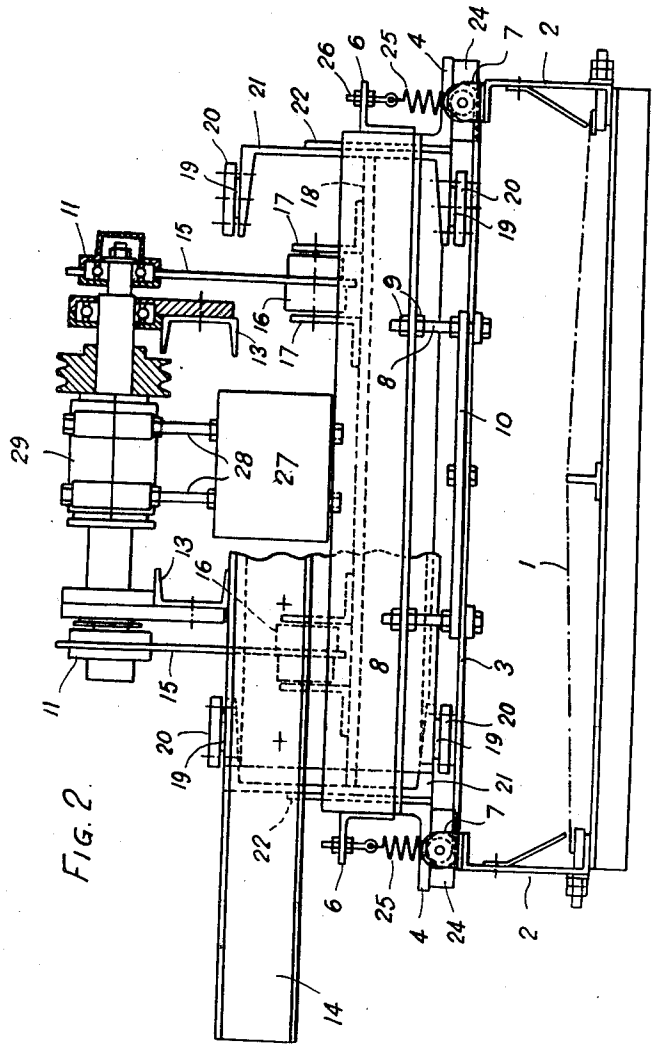


FIG. 2.

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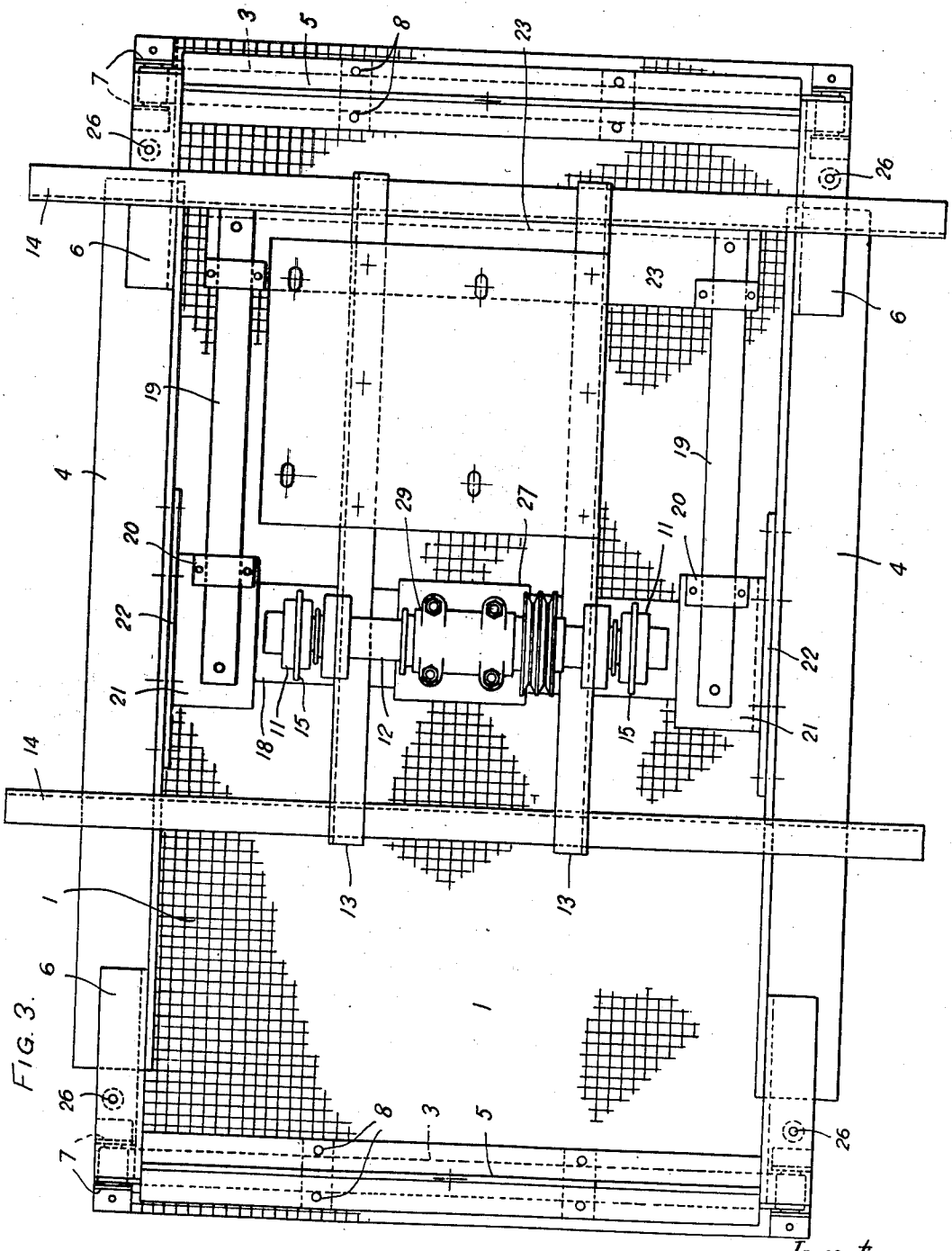


FIG. 3.

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Patented Mar. 5, 1940

2,192,668

UNITED STATES PATENT OFFICE

2,192,668

SCREEN

George Harry Strain, Seaford, England

Application May 2, 1938, Serial No. 205,637
In Great Britain May 10, 1937

7 Claims. (Cl. 209—347)

My British Patent Specification No. 479,466 describes inter alia a screening machine in which the screen is given a vibration having a vertical component, and is stopped in each vibration at its point of maximum upward velocity.

This invention, which is an improvement in, or modification of, the aforesaid invention, consists in a screening machine which comprises a rigid member or anvil, means for imparting to the rigid member a reciprocating motion having a vertical component, and a screen mounted on the rigid member in such a manner that it is normally held in or nearly in, contact therewith by the force of one or more springs or their equivalent, but is free to move against such force away from the position of contact. By this arrangement, a motion is imparted to the screen which makes for increased efficiency of screening, and minimises the vibration and mechanical stress present in known vibratory screening machines.

The motion of the screen depends on the relation between the period at which the anvil is reciprocated and the natural period of the spring loaded by the screen. A typical motion is as follows: During one stroke, for example the down stroke, of the rigid member or anvil, the screen descends with the anvil and for some time remains in contact therewith before the anvil begins its upward stroke. At this point however, the kinetic energy of the screen causes it to lag behind the anvil, and it rises separately from the anvil while the latter completes its upward stroke and has started the down stroke; the screen and anvil strike one another at a position which is about the middle of the stroke. The anvil then forces the screen down, and the cycle is repeated. The inertia of the material on the screen prevents it from following immediately so that it separates from the screen to fall thereon when the screen is approximately at its lowest position.

I have found that the screen remains in step with the anvil and has an efficient screening action so long as the frequency of the anvil vibrations is between 2 and 1½ times the natural frequency of the spring loaded by the screen. The natural frequency of the spring varies with the load, but the range of allowable frequencies is sufficiently large to include the frequencies of an unloaded and a fully loaded screen.

An advantage of the invention is the large amplitude of the vibrations of the screen which are obtained with small vibrations of the anvil. For example in a machine in which the anvil was reciprocated through 0.083 inch at 1000 revolutions per minute the screen moved through ¼ inch. If the screen itself had moved through only 0.083 inch a much greater speed would have been necessary in order to obtain a screening action.

Since the screen and anvil at the moment of impact have opposite momenta, the impact does not cause any serious shock to be transmitted to the bearings and other parts of the machine. If the mass of the anvil is correctly chosen, the opposing momenta can be made equal and the shock reduced to zero; in the case in which the impact occurs when the anvil is moving down the condition of equal momenta involves the use of a comparatively light anvil. As a result the vibration of the machine is in any case less than that hitherto experienced, but the vibration may be still further reduced by a further feature of the invention, which consists in providing a balancing weight rotatably mounted on an eccentric axle which is driven at the same frequency as the reciprocations of the anvil but in opposite phase thereto, the arrangement and dimensions of the weight being such that it hangs freely when the eccentric is stationary, but when the latter is driven the upper part of the weight rotates about the axis of the shaft which drives the eccentric, while the lower part has a reciprocating motion. This the rotating parts of the machine are balanced by the upper part of the weight, while the reciprocating anvil and screen are balanced by the lower part. As a result the machine is quieter than known machines, and is practically free from vibration.

An advantage of the invention lies in the fact that the screening action is not damped by dumping a mass of material onto the screen. This is due to the fact that if the weight carried by the screen is increased, the separation of the screen from the anvil on the up stroke also increases and as a result the impact is more vigorous. Thus a more vigorous screening action is engendered, which quickly disperses the mass.

The invention is illustrated by the accompanying drawings in which:

Fig. 1 is a side elevation of a screening machine,

Fig. 2 is an end elevation partly in section and

Fig. 3 is a plan.

The screen 1 is fixed in a frame 2 which is suspended from the anvil by two pairs of leaf springs 3*a* and 3*b*. The anvil is a framework which consists of two longitudinal angle-section beams 4 and two transverse T-section beams 5 which are welded to angle irons 6 bolted to the beams 4. The leaf springs 3*a*, 3*b* are the free ends respectively of two continuous leaves 3 having eyes 7 which are bolted to cleats 7*a* fixed to the frame 2. The spring eyes 7 are bushed with flexible Silentbloc bearings (registered trademark) which consist of an inner steel sleeve, an outer concentric tube and a ring of rubber compound which is forced in between the sleeve and the tube. The middle parts of the leaves 3 are clamped by bolts 8 which are suspended from

the beams 5 by nuts 9. The periodicity of the leaf springs 3a and b depends on the distance apart of the bolts 8, which is determined by the length of the rigid member 10.

The anvil is driven by eccentrics 11 on a shaft 12 which is mounted on a frame 13 attached to fixed channel beams 14. The motion of the eccentrics is transmitted to the anvil by connecting rods 15 which are journalled in Silentbloc bearings 16 mounted on brackets 17 which are fixed to a transverse T-section beam 18 forming part of the anvil frame. The motion of the anvil is maintained substantially rectilinear by leaf springs 19. These leaf springs are fixed at one end by clamps 20 on channels 21 bolted to plates 22 which are themselves bolted to the beams 4. The other ends of the springs 19 are clamped to a channel 23 fixed to one of the beams 14. When the anvil is set in motion the screen frame oscillates on the springs 3a and b, coming periodically into contact with the anvil. The shock of the impact is lessened by resilient pads 24 of rubber or the like fixed to the beams 4. Normally the screen frame 2 is just in contact with the pads 24 when the anvil is at rest, but if desired the frame may be brought out of contact or its pressure on the pads increased by adjusting the nuts 9. The slight variation of the length of the springs 3 as the screen vibrates is taken up by the resilience of the frame 2.

It will be understood from what has been said above that it is not essential that the periodicity of the leaf springs 3a and b should be exactly adjusted in relation to the period of vibration of the anvil, but it is important in order that the screen may have the most efficient motion possible that the four springs should have the same periodicity. In order to facilitate the adjustment of the periodicity four "tuning" springs 25 are provided. These are attached at one end to the frame 2 and at the other end by bolts 26 to the angle plates 6. Their tension is varied by means of the bolts 26.

The machine can be operated with the screen inclined to the horizontal, the material being fed on to the upper part of the screen. When this is the case the leaf springs are advantageously arranged transversely with respect to the inclined plane of the screen since they then all have substantially the same duty to perform. If on the other hand they are longitudinal with respect to the inclined plane the lower springs are in partial tension and the upper springs are in partial compression thus making it difficult to tune them to the same period.

A balance weight 27 is suspended by rods 28 from a bush 29 journalled on the shaft 12. This balance weight has the motion described above for reducing vibration, but in the machine described, which has a screen area of about 10 square feet, the vibration transmitted to the supports is so small that a balance weight is not absolutely necessary.

I claim:

1. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having its major component perpendicular to the plane of the screen, leaf springs fixed to the said rigid member, and a screen suspended below said rigid member by the leaf springs and resting normally in contact with the said rigid member but being free to move as a whole against the force of said leaf springs away from the position of contact.

2. Screening apparatus as set forth in claim 1 which comprises means for adjusting the effective length of the leaf springs.

3. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having a vertical component, a screen suspended below said rigid member, leaf springs fixed to the rigid member and bearing the major part of the weight of the screen, coil springs fixed to the rigid member close to the respective leaf springs and bearing the minor part of the weight of the screen, and means for adjusting the tension of the coil springs, the screen resting normally substantially in contact with said rigid member but being free to move against the force of the springs away from the position of contact.

4. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having its major component perpendicular to the plane of the screen, leaf springs of equal periodicity fixed to the said rigid member, and a screen suspended below said rigid member by the leaf springs and resting normally in contact with the said rigid member but being free to move as a whole against the force of said leaf springs away from the position of contact.

5. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having a vertical component, a screen suspended below said rigid member, leaf springs fixed to the rigid member and bearing the major part of the weight of the screen, coil springs fixed to the rigid member close to the respective leaf springs and bearing the minor part of the weight of the screen, and means for adjusting the tension of the coil springs, the screen resting normally substantially in contact with said rigid member but being free to move against the force of the springs away from the position of contact, and the periodicity of the leaf springs together with their respective coil springs being the same.

6. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having its major component perpendicular to the plane of the screen, leaf springs fixed to the said rigid member, and a screen suspended below said rigid member by the leaf springs and resting normally in contact with the said rigid member but being free to move as a whole against the force of said leaf springs away from the position of contact, the leaf springs being parallel to the side of the screen into which the material to be screened is to be fed.

7. Screening apparatus which comprises a rigid member, means for imparting to the rigid member a reciprocating motion having its major component perpendicular to the plane of the screen, substantially horizontal leaf springs fixed to the said rigid member, and an inclined screen suspended below said rigid member by the leaf springs and resting normally in contact with the said rigid member but being free to move against the force of said leaf springs away from the position of contact.

GEORGE HARRY STRAIN.