Design of Power Seat

[1]Avinash R. Yadav, [2] Akshay J. Thorat, [3]Ajinkya D. Taware, [4]Rushikesh L. Shinde
Department of Mechanical Engineering,
S.B.Patil College Of Engineering,Pune University,Indapur,India

***Abstract*—The current seat adjustment mechanism in automobiles is quite tedious and outdated and has its toll on the body of the person while adjusting the seat to his/her comfortable position. All the motion of the seat is by mechanical mean which is operated by applying force by the operator .Every person has his/her comfortable seat position, whenever a operator sits occupy his position of operation, there is necessity of seat adjustment as per the operator requirement, this is tiresome and at times annoying.**

This paper deals with automating the seat of an automobile through the use of a electric motors and mechanical mean thereby reducing manual effort in adjusting the seat. A seat which is used in a vehicle and is adapted to assist persons in using the seat and, especially upon entering or leaving the vehicle. The seat includes a motorized control which permits the seat to be moved forward or backward, up or down, and, as well, to tilt from back to front. The adjustment of the seat can be done for lift adjustmemt,adjustment in horizontal plane and it also allow to provide required tilt to the seat by controlling the direction of rotation and speed of the motors provided in the seat. The comfortable position for different individuals can be obtained very easily without much manual effort and saving time.The seat is adjusted to a person's comfortable position by using switch which is used to link the electric motor to mechanical component for a person's comfortable position. Power required to drive the motor is provided from the battery of the automobile.

Index Terms—Forward-backward ,up- down ,seat tilt, motor operated.

I. Introduction

All individual doesn't have same stature some will be taller some will be shorter and few will be with the normal tallness, so for a solitary auto to be taken care of by every individual change of tallness is fundamental. Tallness is to be balanced such the front of the vehicle and the street is plainly noticeable to the driver. Subsequently tallness conformity is essential for driver seat. Simillary a fitting separation between the administrator and control is to be kept up which is accompanished by forward and in reverse movement of seat .it helps in better availability towards the control and legitimate modification of the directing wheel over the thigh area for viable driving posture.a driver can't administrator a vehicle in a stance of 90° for a drawn out stretch oftime and driving in such a position will fumes him in a brief while for simplicity of the driver the lumbar bolster should be adjusted according to the need will and solace of the administrator, so such a plan must be made to full fill everything these need of the driver of a car with the goal that he work effectively and successfully.

A force situate in an auto is a front seat which can be balanced by utilizing a switch or joystick and an arrangement of little electric engines. Most autos with this element have controls for the driver's seat just, however all extravagance autos likewisehave force controls for the front traveler seat.

1.1 Objectives of the present study:

1.To overtake the mechanical seat .
2.To provide the required motion at relatively lower cost.
3.Development of a fully automated seat.
4.Ergonomics based design for the seat.

II. Literature Survey

Raymond E. Welterlin, Douglas R. hillard, Thomas K. Peterreins:

The innovation gives a force seat track engine gathering in which adaptable shafts and right-edge gear boxes of ordinary frameworks are maintained a strategic distance from. The rigging box is an "in-line" apparatus box with an engine having a hub of turn generously parallel to a lead screw. The engine and rigging box are not subject to powers applied on the lead screw, with the goal that all strengths are contained inside of the lead screw and its prompt connections. A littler however higher-working pace engine with a higher apparatus proportion gives the obliged power in a littler bundle with a more worthy sound.

The development gives two encapsulations separately committed to level and vertical movement, yet certain teachings apply to both epitomes. Specifically, the development gives a force seat track engine get together for controlling movement of a seat. The force seat track engine gathering has an engine that has a first hub of revolution, a rigging box having apparatuses that turn because of pivot of the engine, and a strung sink that swings reaction to turning of the riggings in the apparatus box. The strung screw has a second hub of pivot that is generously parallel to the first hub of revolution of the engine so powers forced on the screw significantly by-pass the engine and rigging box. The gathering additionally has a strung structure including a strung opening through which the strung screw is threadably embedded. Either the strung screw or the strung structure is basic with or mechanically connected to the seat, so that turn of the strung screw in respect to the strung gap causes the seat to move. The strung tighten is pressure amid typical operation in order to hold up under the powers that are forced on the screw to generously by-pass the engine and rigging box. No less than one pressure structure, (for example, a bolster section that backings the seat) bears the heaviness of the seat and the seat's tenant to keep the lead fasten pressure.

Stephen Bruck , Javis M. Lutzka

Force situate gathering with engine incited spring discharge and rewind of a seatback division and with the engine expelled from an inertial burden way, for example, amid an effect occasion .The present development is a force situate get together with engine activated discharge and rewind of a seatback segment. To start with and second bolster plates sandwich a forwardly one-sided seatback division and a cam drew in with the seatback segment in an upright position. A first stick stretches out from said cam counterbalance its essential association and goes through an opening characterized in the second bolster plate to characterize a scope of crucial movement of the cam. A toothed apparatus division rotatably mounted to an outside of the second bolster plates and shows a polygonal molded partition and an end shoulder balance and deep down recessed from exteriorly characterized teeth and the polygonal formed part.

An electric engine incorporates a yield outfit in toothed engagement with the apparatus part and for turning the rigging segment in a first heading so that the polygonal molded bit contacts and redirects the pin and cam out of contact with the seatback, making it pivot to a forward dump position. A second stick reaches out from the seatback division and contacts the end shoulder at the landfill position, the engine turning the apparatus segment in a moment course and persuasively rewinding the seatback part, against its inclination, to the upright outline position harmonizing with the cam re-drawing in the seatback area.

Jack M Tulley

A seat which is utilized as a part of a vehicle and is adjusted to help persons in utilizing the seat and, particularly after entering or leaving the vehicle. The seat incorporates a mechanized control which allows the seat to be advanced or in reverse, up or down, and, also, to tilt from back to front. Furthermore, the swivel seat pivots on a vertical hub through a circular segment of roughly 90°. The seat utilizes considerably the same space as is as of now needed for flexible seats in vehicles.

Sasche Softong

The creation is in view of the goal of adding to a control gadget of the force seat which gives high working solace and in which the quantity of switches is at the same time decreased. As indicated by the development, this goal is accomplished because of the way that one switch comprises of a selector switch for distinctive exchanging menus of the customizable locales of the seat parts, and the way that the other switch is acknowledged as a multi-capacity switch for understanding the changes of the separate areas of the seat part. Because of these measures, the quantity of switches for controlling engine administrators that serve for changing the different parts of the seat is diminished. Since one and only multi-capacity switch is accommodated understanding the conformities and stand out selector switch is accommodated selecting the locales of the seat parts to be balanced, it is not important to choose one change from a generally substantial number of changes to understand the sought alteration of the seat. Subsequently, the convergance of the driver on the activity is basically not debilitated. The mix of the selector switch and the multi-capacity switch thus makes it less demanding and speedier for the client to understand the different alterations of the seat, with the control gadget all the while giving high working solace. The different alterations of the seat or the seat parts, individually, can be controlled, for instance, by method for a various incitation of the selector switch. For this situation, the changes of the seat are doled out to inciting headings of the multi-capacity switch which dependably continue as before.

III. METHODOLOGY

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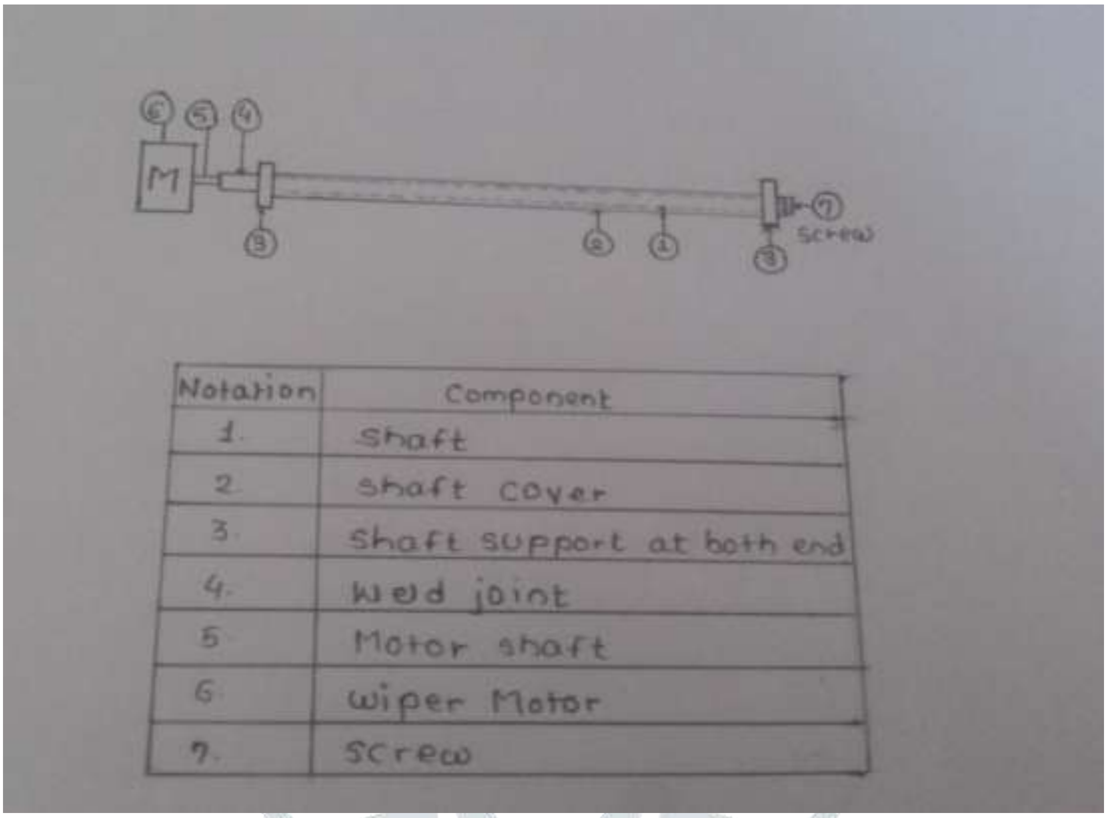
Design of Power Seat

1.**SEAT BACKREST TILT**

Here we provide tilting motion to backrest. We use a wiper motor which has reduced output speed which is direct coupled to the shaft on which seat is mounted. The rotation shaft of shaft provides rotation to the backrest. The locking mechanism in terms of plates are provided to stop the rotation of backrest after particular degree rotation toward right is 90° and towards left is 20°.

Design of shaft:



Notation	Component
1.	Shaft
2.	Shaft cover
3.	Shaft support at both end
4.	Weld joint
5.	Motor shaft
6.	wiper Motor
7.	Screw

Available data :
Syt = 275 N/mm^2
τallowable = 0.3 * 275 = 82.5 N/mm^2
speed (N) = 15 rpm
motor torque (T)= 38 Nm
calculation :
1. power calculation
P = 2πN*T/60
2*3.14*15/60 = P

P = 59.69W
2. using torsion formula
$\frac{T}{J} = \frac{\tau}{R}$
$\frac{38*10\text{^}3}{(\pi/32)d^4} = \frac{82.5}{d/2}$
d = 13.045 mm ~ 14 mm
3. J = $(\pi/32)d^4$ = 3771.482 mm^4

4. check for safety
$\frac{T}{J} = \frac{\tau}{R}$
$\frac{38*10\text{^}3}{3771.482} = \frac{\tau}{7}$
$\boldsymbol{\tau = 70.529}$ **N/mm^2**

Hence the stress is within the permissible limit of the selected material
Design is safe .

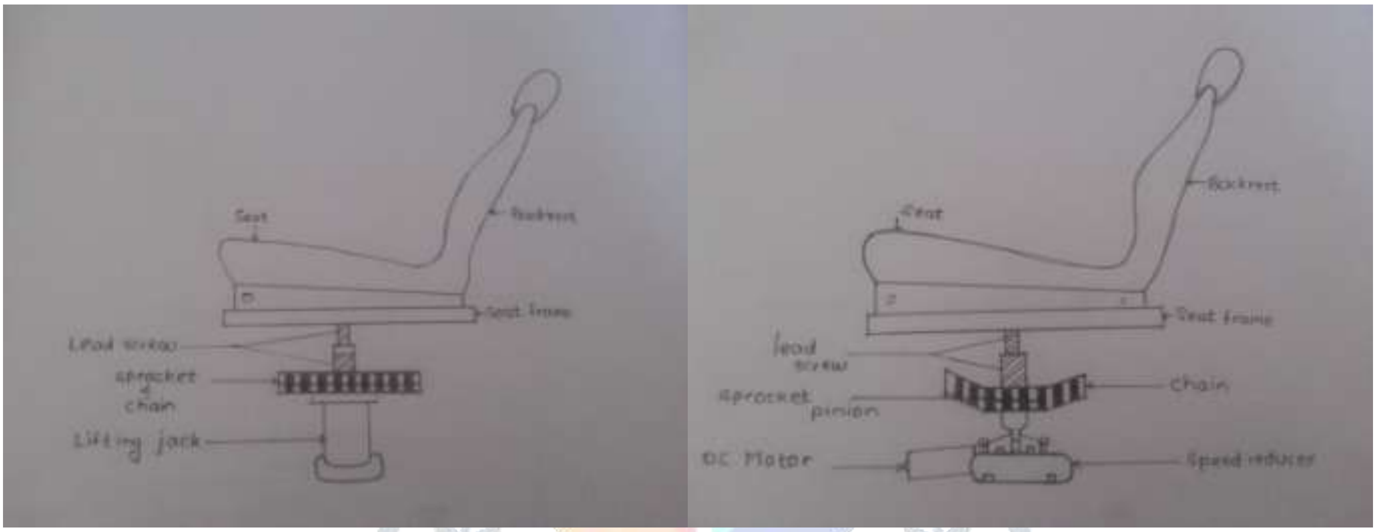
5. Angle of twist

$\theta = \frac{TL}{GJ}$

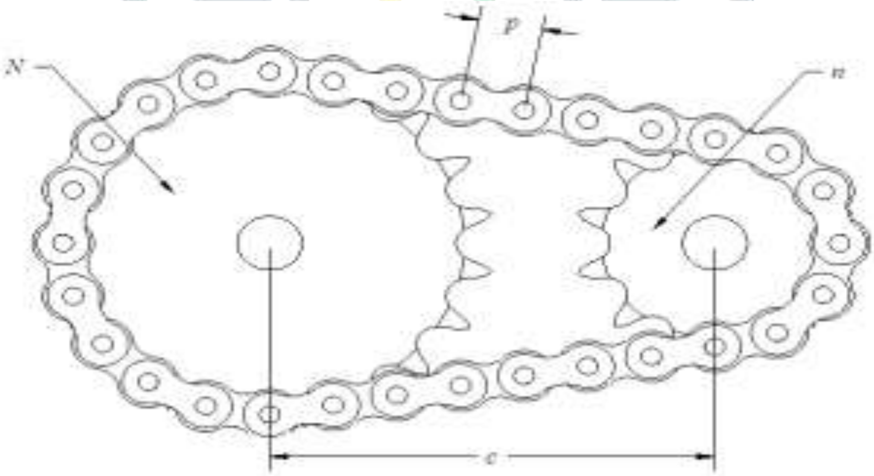
θ = 0.057 radian

2.SEAT HEIGHT ADJUSTMENT

Here we are using a chain sprocket mechanism which is driven by a wiper motor of 12 v the sprocket pinion is used to drive lead screw.the lead screw is coupled to the seat base which lift and lower the seat when operated using switch. The mechanism provide a height adjustment of 10 cm which is more than provided by any other mean.



Design of chain drive:



(i) Pitch of chain(p):

It is the distance between a hinge centre of one link and corresponding hinge centre of adjacent link.

p= 12.5mm

(ii) Pitch angle(¥) :

It is an angle between two lines joining the centre of the sprocket and and hinge centres of two adjacent links , when chain is wrapped around the sprocket.

¥ =360/z

Where ,

z=no. Of teeth on sprocket

(iii) Pitch diameter of sprocket (D):
It is the diameter of circle that it locus of hinge centre of links, when chain is wrapped around the sprocket.

We know,

Sin[¥/2] =[(p/2)/(D/2)]

D=p/[sin(¥/2)]

D=56.17mm

(iii)Speed ratio(n):

$n = z_1/z_2$

Thus,

Z_2=14*3=42

Approximately,

Z_2=45

(iv) No. Of links(M):

$$M = 2\left[\frac{C}{p}\right] + \left[\frac{z1 + z2}{2}\right] + \left[\frac{z1 - z2}{2\pi}\right] * \left[\frac{z1 - z2}{2\pi}\right] * [p/C]$$

M=57.95mm

Where ,

C=Centre distance=180mm

z_1=no. Of teeth on driving sprocket

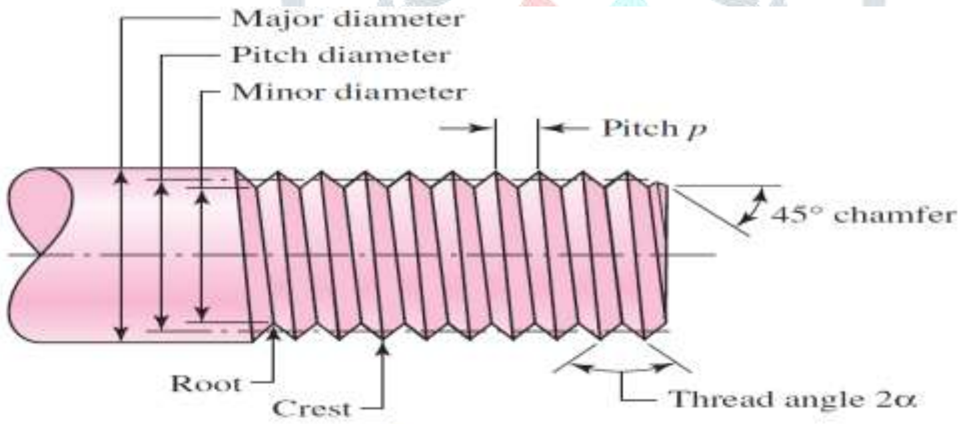
$z_{2=}$ no. Of teeth on driven sprocket

(v)Corrected centre distance:

$$C = p/4\{\left[M - \left(\frac{z1+z2}{2}\right)\right] + \sqrt{\{\left[M - \left(\frac{z1+z2}{2}\right)\right]^2} - 8([z1 - z2]^2)/2\pi\}S$$

C = 193.182 mm

Design of screw jack



Terminology of Screw Threads

Available Data:

Design of toggle jack for load capacity 1.5 KN and lifting height of 10 cm

1. Tensile and compressive yield strength of screw material = 460 N/mm^2
2. Coefficient of collar friction=0.16
3. Factor of safety=3

Design:

Design of screw Body:

(i) Core diameter ‘d_c‘ of the screw:

The permissible compressive stress for screw material is,zz

$\sigma = S_{yc}/N_f$ =460/3

σ =153.33N/mm^2

(ii) Direct compressive stress induced in screw body

$\sigma = W/ (\pi d_c^2/4)$

$153.33 = (10*10^3) / \pi d_c^2/4)$

d_c =15mm

(iii) Select Standard square thread for screw

From standard table ,**d_c=16mm**
d=20mm
p=4mm

Mean diameter,
$d_m = d-(p/2)$
d_m=18mm

(iv) Torque required to overcome threaded friction,

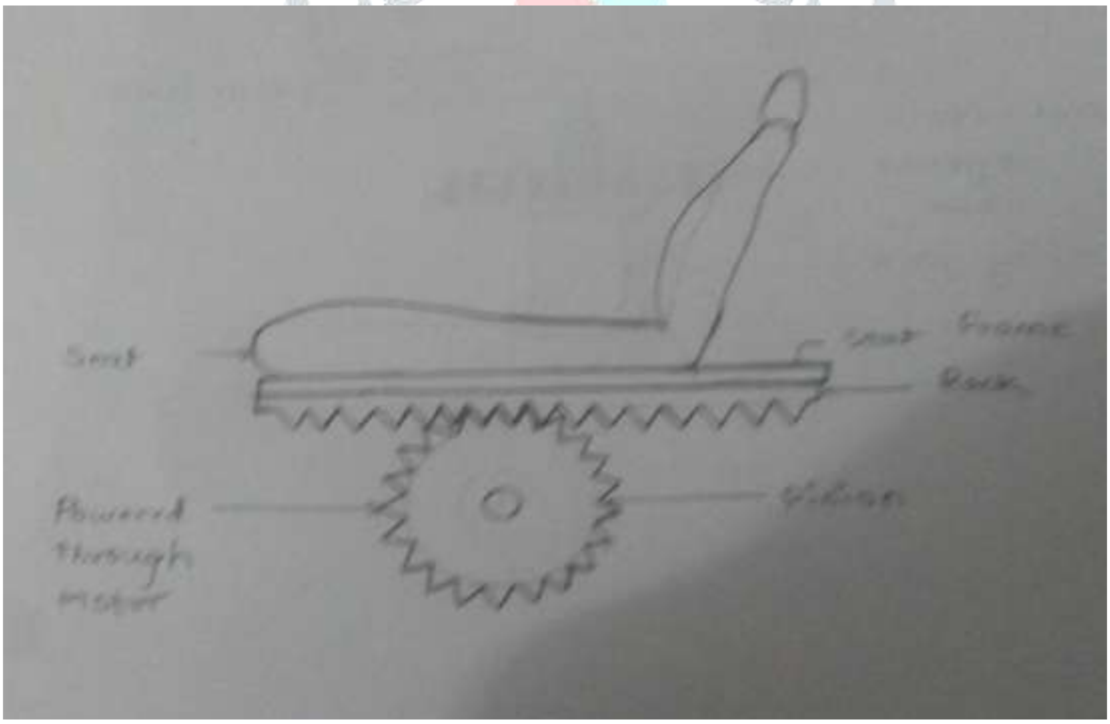
$\lambda = \tan^{-1}[p/ \prod d_m]$
$\lambda = 4.046^0$
$\varphi = \tan^{-1}(\mu)$
$\varphi = 7.9696^0$
since, $T_t = (Wd_m/ 2)*[\tan(\varphi+\lambda)]$
T_t =104.39 N.mm

(v)Torque required to overcome collar friction,
Radius of screw head,
$R_0 = 0.875d = 17.5mm$
Inner radius of collar,
$R_i = R_0/4 = 4.5mm$
Thus,
T_c =5782.54N.mm

(vi)Total Torque,
$T = T_t + T_c$
T=5887N.mm

3.SEAT FORWARD AND BACKWARD MOTION

We have used a rack and pinion assembly for providing this motion.a rack is attached to the seat frame which is driven by pinion powered through a wiper motor.the power of the motor is sufficient to move the seat at such a speed that it takes minimum time to adjust the seat position by the driver.



Design calculation :
Design of Rack:
Rack-Cast iron
Pinion-Cast iron
σu<390 N/mm²
σb =30 N/ mm²

Calculation of centre distance Corresponding Number of starts:
Z=3
Z = iZ
24*3=72

Check whether Z lies between 25 and 85
Choose q=11
Assume (σc) = 159 N/ mm^2
Assume kkd = 1

Wheel torque = power * 60/2π* rpm of the pinion
= 60*60/2π*20 = 38.21Nm
[Mt] = k。kd Mt
= 1*1*38.21= 38.21 Nm

a =[(Z÷q)+1]³v[540÷ (72÷11)×σc]^2.[38.21×10³÷10]
a = 23.19 mm

Calculation of Axial module :
mx = 2a /(Z+q)
= 0.55 mm
mx = 5 mm (standard)

REVISE a and OBTAIN d1
a =0.5 mx (q+z)
= 207.5 mm
Pitch circle diameter of rack(d1)= q * mx
= 11 * 5 = 55 mm
tan γ=z÷q
γ = 15.25°
Vs=V1÷cosγ

V1 = πd1n1÷(60*1000)
= π×55×15÷(60×1000)
= 0.0439 m/s
Vs = 0.0455 m/s
SINCE Vs < 4m/s, the [σc] is correct

REVISE k,kd and [Mt] for the actual pitch line velocity of the pinion
V2=rack speed(rpm)×lead÷(60×1000)
= 15×3×π×5÷(60×1000
= 0.00785m/s
Since V2=0.00785m/s<3m/s, kd=1
[Mt]=k.kd.Mt
1×1×38.21×10³
=38.21×10³ N/ mm^2

Determination of Induced Stress:
σc ==540÷(z÷q)v[((z÷q)+1)÷a]³.[Mt]÷10
=540÷(z÷q)v[((z÷q)+1)÷a]³.[Mt]÷10
=14.45N/mm²<[σ c]=159N/mm²

σb=1.9[Mt]÷m³xqzyv
=1.9×229×10³÷(5³×11×72×0.499) yv =0.499(for 80 teeth)
= 14.6N/mm²<[b]=30N/mm²
Zeq=z÷cos³γ
= 80
Basic Dimensions:
Rack:
L =(12.5+0.09 Z)MX
=(12.5+(0.09×72)15
= 278 mm
L1=L+35(grinding allowance)
=278+38
= 316 mm

Number of Threads on Rack
=L1÷ mx
=319÷(π5)
=21

Actual Length of Rack
=21× π5
=330 mm
Pitch diameter of the rack=55mm
Tip diameter da=d1+2mx
55+(2×5)=65

Root diameter df1=d1-2mx-2c
=55-(2×5)-2×(0.3×5)
= 42 mm

Design of Pinion
Face Width of the Pinion
b =0.75 d1= 42 mm
Pitch circle diameter of pinion,d2=z * mx
=72×5
=360 mm
Tip diameter of the wheel,da2=(z+2)mx
= 370 mm
Maximum pinion diameter de2=da2+1.5mx
=370+(1.5×5)
= 378 mm
Root diameter of the pinion
df2=(z-2)mx-2c
=(72-2)5-(2×0.3×5)
=347 mm

Specification of Rack
Material- Cast iron
Module=1.5mm
Cross section=58×25mm
Teeth on the rack is adjusted for 86mm

Specification of Pinion
Outside diameter=58mm
Material- Cast iron
Module=1.5mm
33Pitch circle diameter=55mm
Circular pitch=4.7mm
Module=1.5mm
Pressure angle=21°
Addendum=1.5mm
Dedendum=1.8m
Circular tooth thickness=2.35mm
Fillet radius=0.45mm
Clearance=0.375

Expected Load Can Handle
P= F * v
The power getting in pinion after all reduction
=60 W
F= ma
m=?
F= p/v
=(60)÷(0.045) = 1500 N
m = F/a
=1500/0.1
=150 kg(including rack weight)

IV. Result & Discussion

The results obtained for the corresponding six way motion are given below:
1.Seat backrest tilt is 90° towars right and 20° towards left.

Seat backrest tilt is same as that provided in the power seat which are used in automobile nowadays,hence there is no problem is adapting this design of seat as far as tilt is considered.

2.Seat can be easily adjusted upto a height of 10 cm according to the requirement of the driver of the automobile.

The height adjustment of 10 cm is more that is usually provided in the power seat used nowadays,that is the advantage over power seat as well.it can lift a load upto 150 kg with ease hence a driver with a small height than average and those who are bulky can also be provided with their best possible comfort for driving

3.Seat can be moved in forward and backward motion upto 40 cm by carrying a mass upto 150 kg.

This motion is very important in any automobile seat because the driver has to adjust the automobile seat to get correct steering posture. This design of power seat provide 40 cm of axial travel which is enough for the required seat adjustment.

V. FUTURE SCOPE

Further work and studies on the automated power seat. Below are some of the recommendations for further studies:

1.The present power seat provide 6 way motion which is fully automated with the help of motor along with this ,In the future power seat can also be use to store coordinate as per the operator. Storage of the adjustment as per the operator so that it reduces the time of operation in adjustment where he operate the seat for the next time and help in fine adjustment of the seat.

2.In the future a power seat with eight ,ten & twelve way motion can be made which provide more dextericity to seat and comfort to the operator

VI. CONCLUSION

The present power seat used in car like Mercedez Benz provide height adjustment upto 2 -5 cm, forward and backward upto 40-50cm and tilt upto 110-135°. In present investigation we have used three wiper motors for providing three automated motion of seat. A wiper motor coupled to shaft is used for seat tilt. Seat is mounted of the shaft which is supported at the two end. It provide seat tilt of 110 degree. Another motor coupled to a rack and pinion through a gear train is used for forward backward motion .it provide a motion length of about 40 -50 cm which is very helpful for driver during seat adjustment .this two motion is normally available in all seat but they may be mechanically powered or powered through motor the most important motion which make a power seat fall apart from other is the height adjustment which is made possible by using a motor is connect to chain drive by means of sprocket the output of the sprocket drives the lead screw which is used to lift the seat.a total adjustment of 10 cm is possible. The whole seat assembly is mounted on the bar frame which is supported by means of lead screw.

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